MOTREC

T-448HD

OPERATOR AND MAINTENANCE MANUAL
SPARE PARTS LISTS INCLUDED

SERIAL NUMBER : 1006000 & UP

Printed in Canada

One Year Limited Warranty

Effective April 25, 2005, MOTREC, Inc. (MOTREC) hereby warrants to the Original Retail Purchaser (Owner) that any of its vehicles shall be free from any defect in materials for a period of 90 DAYS while in the possession of such Original Retail Purchaser. This warranty IS NOT TRANSFERABLE to any subsequent Buyer.

The warranty period is extended to one year or one thousand (1,000) hours, which ever first occurs, on the electric motor, differential (parts that bathe in oil) and the electronic speed controller. MOTREC makes no warranty or representation with respect to the internal combustion engine, tires and batteries, since their respective manufacturers cover such parts. Accessories (light, gage, horn, etc), electrical contacts (switch, solenoid, contactor, relay), diodes & fuses, belts & pulleys, filters & spark plugs, lubricants, brake linings & shoes, brake drums & discs, seals, seats, trim and other items subject to wear are not included in this warranty; nor is any item that in MOTREC sole opinion, shows evidence of neglect, misuse, abuse, collision or alteration.

This warranty shall not apply to normal maintenance requirements as described in the User Manual, and to damages during shipment. The latter is the carrier's responsibility. No compensation will be allowed for delays.

To initiate warranty coverage on any MOTREC vehicle, the Dealer must complete and return the “Sales/Installation Report” to MOTREC within 30 days after delivery to the Original Retail Purchaser; or within 90 days after the delivery date to the Dealer, which ever occurs first. Failure to follow these procedures will result in considering the warranty coverage effective as of the shipment date from the factory.

The defective vehicle must be returned, at the Owner's expense, to an authorised MOTREC Dealer within 30 days after failure. The Owner will not be charged for parts and labour required for warranty repairs, which must be performed by an authorised MOTREC Dealer only. The vehicle will be returned at the owner’s expense. The Warranty Claim Forms must be completed and returned with the defective part(s) to MOTREC within 30 days after repair was done. No compensation will be allowed for damages caused by vehicle downtime.

It is the responsibility of the owner of the vehicle to make sure that the driver is properly trained and instructed in the safety features and operation of the vehicle, including vehicle stability, as required by OSHA and ANSI-B56. Operators shall read, understand and follow the safety and operating instructions in MOTREC Manual before driving the vehicle. Operators shall not be permitted to drive the vehicle unless a complete and adequate training has been provided. Driving a vehicle constitutes a hazard. The driver is responsible for the control of the vehicle while driving and must always evaluate and care for all peculiar situations that he or she may meet while driving. The driver assumes the inherent hazards related to this activity. The vehicle is designed for off-road use only. MOTREC disclaims any liability for incidental or consequential damages, to include, but not be limited to, personal injury or property damage arising from vehicle misuse, lack of maintenance or any defect in the vehicle.

It is the responsibility of the Owner of the vehicle to make sure that the service technicians are properly trained as required by OSHA and ANSI-B56. Service technicians shall read, understand and follow instructions in the MOTREC manual before servicing the vehicle. Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect the vehicle.

MOTREC prohibits, and disclaims responsibility for, any vehicle modification altering the weight distribution and stability, increasing the speed or affecting the safety of the vehicle. Such modifications can cause serious personal injury or property damage for which MOTREC disclaims any responsibility.

For Owners that are located outside North America, the warranty period starts the date of shipment from the factory, and the defective parts must be returned at the Owner's expense to MOTREC prior to warranty repair.

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INSTRUCTIONS

SAFETY WARNINGS FOR OPERATORS

- FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAIN RESULT IN SEVERE INJURY.
- It is the responsibility of the owner of this vehicle to train operators to ensure that they understand the operating characteristics of this vehicle, including training in vehicle stability, and obey the following safety rules and guidelines. Owner shall comply with OSHA and ASME/ANSI B56.8 & B56.9 regulations for vehicle use, safety rules, operator training and certification. Do not drive this vehicle unless you are a qualified operator.
- Do not drive this vehicle under the influence of drugs or alcohol.
- Do not drive this vehicle on public roads and highways. This vehicle is designed to be driven in buildings.
- The electrical system of this vehicle will make sparks which can ignite inflammable materials. Never use the vehicle in hazardous areas where there are inflammable materials, explosive dust or fumes in the air.
- Have your vehicle inspected regularly by trained personnel, and cease operation if a malfunction occurs.
- Do not open battery compartment to prevent battery explosion, acid splashing, severe damage to eyes or skin.
- Do not open motor compartment. Keep clear from moving, rotating(wheels, sheaves, etc) or lifting parts.
- Never carry more passengers than number allowed for this vehicle. Wait until all occupants are seated and holding on before moving. Always keep all body parts inside vehicle. Keep both hands on steering wheel.
- Do not exceed the vehicle cargo load capacity and gross trailing weight capacity, rated for flat hard even surface. Different operating conditions such as loose terrain or ramps reduce vehicle capacity.
- Avoid loose, unbalanced or top-heavy loads to keep a good stability and prevent overturn. Do not load cargo that can fall off the vehicle. Do not carry cargo that is longer, wider or higher than this vehicle.
- Always depress slowly the accelerator for smooth acceleration. Avoid stunt driving or horseplay.
- Avoid sharp turns, always slow down before turning, to prevent vehicle overturn or trailer jack knife. Vehicle is more sensitive to overturn and jack knife when traveling on inclines or when carrying a heavy load.
- Always drive straight up and down the face of an incline, never across the face, to prevent overturn and trailer jack knife. Drive slower and start applying brakes sooner on inclines to adjust for longer stopping distance.
- Use extra care and drive slowly in reverse, in congested areas or on wet or slippery ground.
- Keep to the right under normal conditions. Maintain a safe distance from all objects.
- Slow down and sound the horn when approaching a corner or other blind intersections.
- Before leaving the vehicle, park on a level ground flat surface, turn off all switches, set the forward/reverse switch to neutral, set the parking brake, remove the key. Do not park the vehicle on an incline.
- Before battery charging, park the vehicle in a well ventilated area set for. Do not operate it when charging. To interrupt a charging cycle, disconnect the AC plug; disconnecting the DC plug or a battery terminal, or operating the vehicle, could damage the charger and produce a spark, battery explosion and acid splashing.
- Use another driver to steer this vehicle while it is towed. Be sure the driver uses brakes when you slow or stop the towing vehicle. Do not exceed 5 MPH or carry any passenger while towing this vehicle.

OPERATING INSTRUCTIONS

It is the responsibility of the owner of this vehicle to ensure that the operator understands the operating characteristics of this vehicle, and obeys the safety instructions (ANSI B56).

Do not drive this vehicle unless you are a qualified operator.

BEFORE USING VEHICLE

Before turning on key switch: set to neutral, check for any visible damage, check brake pedal.

BATTERIES

Never open the battery compartment unless you have received proper training for battery maintenance. Batteries emit explosive hydrogen gas that can be ignited by a spark or loose terminal. Battery acid causes severe damage to eyes or skin. Flush the contaminated area immediately with water.

BATTERY CHARGER

Park the vehicle in a well ventilated area for battery charging. Most battery chargers come with an electronic control that starts when the charger is plugged and stop when the battery is fully charged. To interrupt the charging cycle, disconnect the AC-plug, do not disconnect the DC plug.

BATTERY DISCHARGE INDICATOR

The green light moves from right to left as batteries are being discharged. When the green light is at the last position on the left the batteries must be recharged. A flashing light warns the operator that further discharge will damage batteries. See HOBBS indicator instructions

KEYSWITCH

Depress brake pedal and turn the key switch clockwise for on position. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

HORN

Depress the horn button on the steering column or handle bar.

F/R SWITCH

Three positions with neutral at center. Depress the front part of the rocker switch for forward direction. Depress the rear part of the rocker switch for reverse direction. Always set switch to neutral, turn off all switches, set the parking brake, remove the key before leaving the vehicle.

ACCELERATOR PEDAL

It is designed for right foot operation only, and controls the speed of the vehicle.

FOOT BRAKE PEDAL

It is designed for right foot operation only. The brake force is proportional to the pressure on the pedal.

PARKING BRAKE

Pull handbrake lever to apply. Never park the vehicle on an incline. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

MAINTENANCE

SAFETY WARNINGS FOR SERVICE TECHNICIANS

FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAIN RESULT IN SEVERE INJURY.

Owner shall comply with OSHA and ASME/ANSI B56.8 & B56.9 regulations for vehicle maintenance.

Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect carriers, vehicles, tractors, and batteries.

Before any maintenance work, park the vehicle on flat level surface, turn off all switches, remove key, lift wheels off the ground and secure with jack stands of adequate capacity. Don't connect charger.

Keep clear from moving parts such as tires, sheaves and motor.

Follow the maintenance instructions applicable to the type of repair, maintenance, or service.

Always wear a face shield and gloves when working around batteries.

Before opening the battery compartment, disconnect the charger, turn off all switches and remove the key. Batteries emit highly explosive gases which greatly increase when charging; do not disturb connections or produce sparks around batteries to avoid a battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.

Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.

Use two counteracting tools, double-wrench technique, when disconnecting or tightening terminals on the battery and the speed controller to avoid cracking the terminal or battery post welds.

Before cleaning or replacing a battery, charger, speed controller, contactor, relay, diode, or any other component in the power circuit, always disconnect the charger, turn off all switches, remove the key, wear a face shield and gloves, identify battery polarity and disconnect battery leads, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-.

After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

On EE rated vehicles, make sure that all the additional protectors are properly installed and that the static strap makes a good contact with the ground.

Keep cables and wires clear from mechanical and rubbing action. Make sure cable insulation is free from cutting or visible damage.

Before replacing a fuse or circuit breaker, identify the cause of failure and repair.

Programmable controllers must be programmed using the parameter settings in this service manual, before connecting the motor, to avoid sudden vehicle movement and accident.

Do not try to increase motor speed by changing parameter settings in the speed controller; it can cause accident and severe damage to the motor.

SEPEX speed controls are protected by a diode in the power circuit to filter inductive loads in the event of a sudden power interrupt. Some speed controllers require a diode to filter inductive loads on the KSI input. Removing the diodes will cause the speed control failure.

Before resuming maintenance operations, inspect safety warnings stickers and replace any if damage is found and part of the text can’t be read.

DECALS AND LABELS

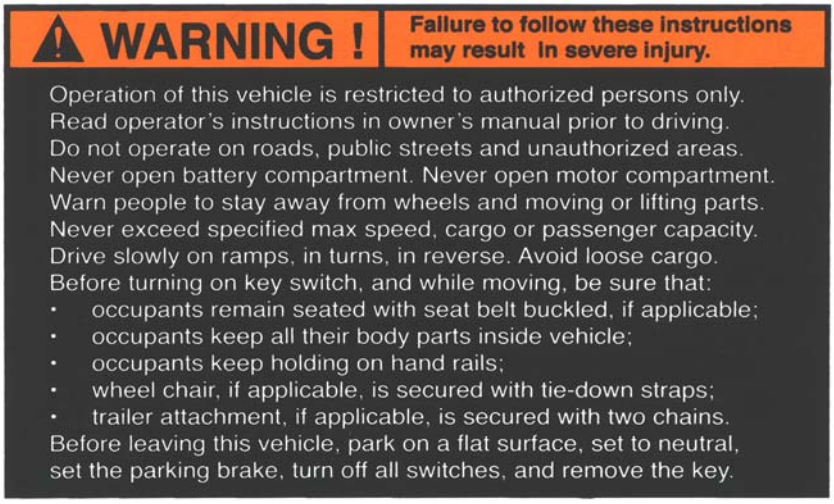
! CAUTION !

The images included in this section depict the decals/markings installed on the vehicle. It is of prior importance that theses decals/markings remain unaltered and readable. Else, the sticker or the part bearing the marking has to be replaced.

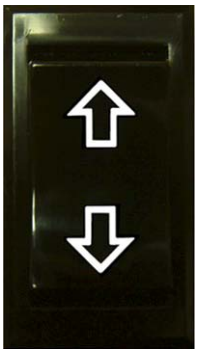
Dashboard security warning label:

WARNING !
Failure to follow these instructions may result in severe injury.
Operation of this vehicle is restricted to authorized persons only.
Read operator's instructions in owner's manual prior to driving.

General security warning label:


WARNING !
Failure to follow these instructions may result in severe injury.
Operation of this vehicle is restricted to authorized persons only.
Read operator's instructions in owner's manual prior to driving.
Do not operate on roads, public streets and unauthorized areas.
Never open battery compartment. Never open motor compartment.
Warn people to stay away from wheels and moving or lifting parts.
Never exceed specified max speed, cargo or passenger capacity.
Drive slowly on ramps, in turns, in reverse. Avoid loose cargo.
Before turning on key switch, and while moving, be sure that:
• occupants remain seated with seat belt buckled, if applicable;
• occupants keep all their body parts inside vehicle;
• occupants keep holding on hand rails;
• wheel chair, if applicable, is secured with tie-down straps;
• trailer attachment, if applicable, is secured with two chains.
Before leaving this vehicle, park on a flat surface, set to neutral,
set the parking brake, turn off all switches, and remove the key.

Respectively, key switch markings, forward/reverse selector markings and light switch marking:



PERIODIC MAINTENANCE CHECKLIST

! WARNING !

Maintenance operations must be made by properly trained service technicians.

- Keep clear from moving parts such as tires, sheaves and motor.
- Check for all EE protections, when applicable, and keep cables and wires clear from mechanical and rubbing action
- Batteries contain sulphur acid that can cause severe burns on skin or eyes.
- When working around batteries, wear acid proof protective equipment: face shield and gloves.
- Use electrically insulated tools to avoid sparks that can cause battery explosion.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity, identify and disconnect battery leads. Don't connect the charger.

PERIOD CHECK/PERFORM HOURS	DAY	WEEK 20	MONTH 50	QUART. 200	YEAR 1000	2 YEARS 2000
MECHANICAL DAMAGE, OIL LEAKS	**X**					
REVERSE ALARM, DEADMAN SWITCH	**X**					
TIRE PRESSURE, pressure rating on tire		**X**				
CHECK/FILL BATTERIES, add distilled water to cover plates. Fill to recommended level after batteries have been fully charged.		**X**				
MASTER CYLINDER FLUID (DOT 3)			**X**			
BRAKE PEDAL TRAVEL 2" (50 mm) maximum travel			**X**			
STEERING FOR PLAY			**X**			
PARKING BRAKE LEVER requires 10 lbs. (5 kg) force to apply			**X**			
BELTS AND PULLEYS -10 lbs (5kg). force for 1/8" (3mm) deflexion; -pulleys alignment, see procedure.				**X**		
CLEAN/TIGHTEN WIRE TERMINALS				**X**		
WASH BATTERY TOP WITH WATER				**X**		
MOTOR BRUSHES FOR WEAR -brushes must exceed holders				**X**		
ACCELERATOR ADJUSTMENT -1/8" (3 mm) travel to activate micro-switch; -0 to 50 ohms when micro-switch activated; -4500 to 5500 ohms with pedal down.				**X**		
HYDR. BRAKE LINES FOR LEAK				**X**		
STEERING ASSEMBLY, as instructed				**X**		
BRAKE MECHANICAL LINKAGES for wear & play				**X**		
BRAKE LININGS FOR WEAR 1/16" (1.5 mm) minimum lining thickness.				**X**		
LUBRICATE brake pedal pivots, steering column, ball joints and kingpins.				**X**		
OIL (SAE 30) LEVEL IN DIFFERENTIAL Before adding oil, check oil seals for leaks.				**X**		
FRONT WHEEL BEARINGS PLAY				**X**		
TIGHTEN NUTS/BOLTS, electric terminals; drive; steering; brakes; suspension; body.				**X**		
REPLACE DIFFERENTIAL OIL(SAE 30)					**X**	
CLEAN AND RE-PACK FRONT HUBS					**X**	
SERVICE DIFFERENTIAL, replace the three oil seals, wheel bearings, oil (SAE 30)						**X**

ACCELERATOR

GEAR

- Remove the cover.
- Backlash between gears must be reduced to a minimum by sliding holder; use locktite 262 to lock the three screws.
- When the plastic gear is fully depressed a small backlash must remain between the gears.
- When the plastic gear is released its rear portion must not exceed the pedal case.

MICRO-SWITCH

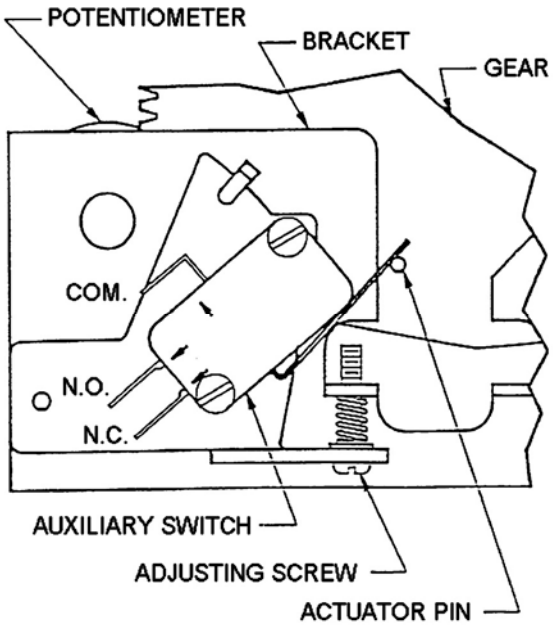
The micro-switch must deactivate the on/off solenoid when the accelerator is released; turn the adjusting screw (shown on figure below) to adjust the micro-switch height.

POT

- Remove the terminals 2 and 3 on PMC to measure resistance signal.
- When the micro-switch is activated the signal must be less than 50 ohms. When the front portion of the pedal is fully depressed the signal must be more than 4600 ohms.
- To modify the resistance, turn the adjusting screw to change the micro-switch height (see figure below).

Proceed with the same verifications after the accelerator cover is on and then connect terminals 2 and 3.

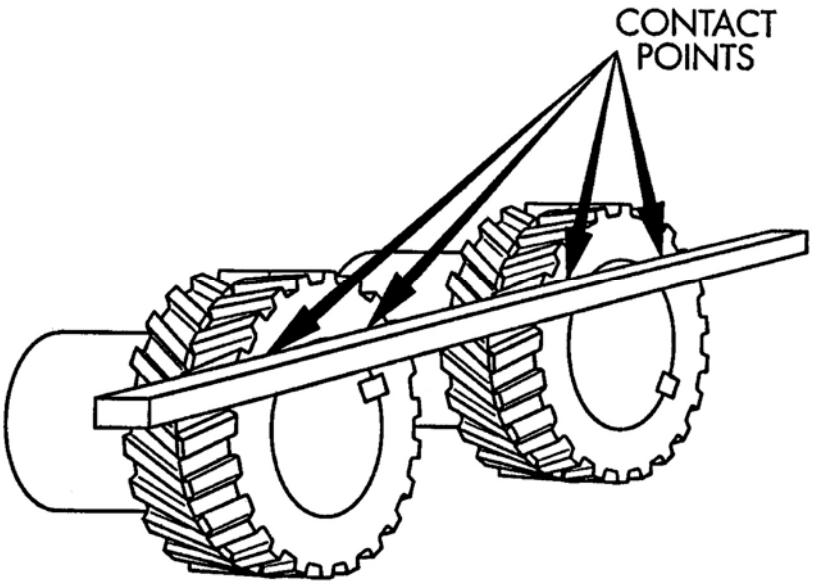
AUXILIARY SWITCH IS WIRED N.O. WITH BLUE LEAD TO COM. & ORANGE LEAD TO N.O. CIRCUIT. THE GREEN LEAD IS GROUNDED. AUXILIARY SWITCH IS SHOWN WITH THE TREADLE IN THE UP POSITION. SWITCH WILL ACTUATE AT BEGINNING OF TREADLE STROKE. SYMBOLS COM., N.O. & N.C. ARE TERMINAL MARKINGS, AS MARKED ON SWITCH.



BELT INSTALLATION AND TENSIONING

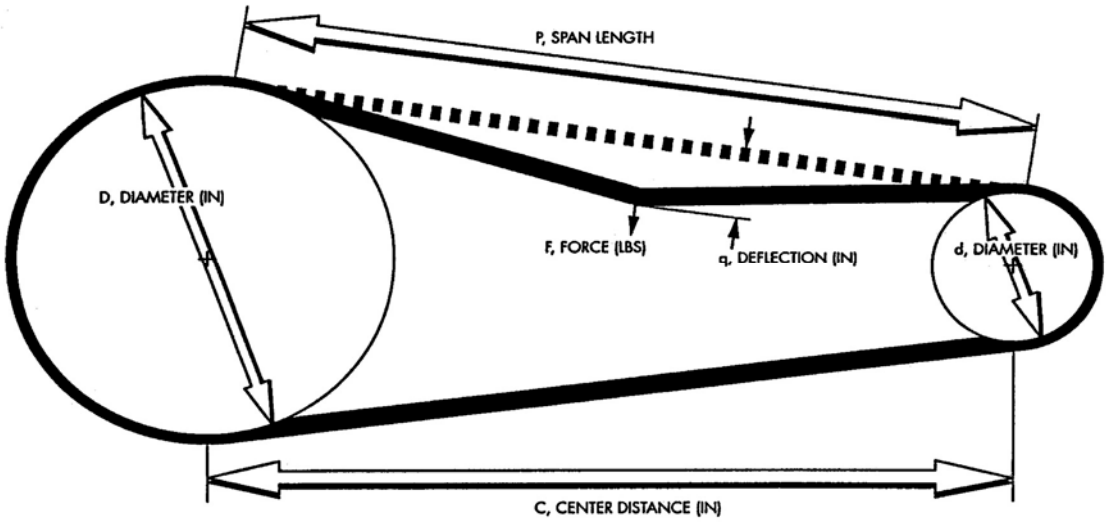
INSTALLATION

Adjust the sprockets using a straight edge. Slide up the edge on the larger pulley until it contacts the smaller pulley. Properly adjusted pulleys will provide three points of contact. Properly aligned pulleys will provide four points of contact. Tighten setscrews and recheck alignment.



TENSIONING

Check the force F required to provide a deflection of 1/8 in. If the measured force is less than 15 lbs then lengthen centre distance C.



HYDRAULIC BRAKES

DRUM BRAKES

Remove brake drums and check linings wear; the linings should have a thickness exceeding 1/16" (1.5 mm). Turn the brake adjustment to reduce the clearance between lining and drum but avoid contact or drag when the wheels are turned and the pedal is released.

DISC BRAKES

Check pad linings for excessive wear; the linings should have a thickness exceeding 1/16" (1.5 mm). Disc brakes are self-adjusting.

BRAKE PEDAL

If the brake pedal becomes soft or spongy, air may have entered the hydraulic system and the brake system has to be bled:

1. fill the master cylinder with brake fluid (DOT-3);
2. bleed front callipers one at a time by having someone applying a steady pressure on the brake pedal, and close the bleeder before allowing the brake pedal to return to up position;
3. fill the master cylinder with brake fluid (DOT-3);
4. bleed rear wheel brakes one at a time, following the same procedure;
5. fill the master cylinder with brake fluid (DOT-3);
6. clean every fitting and line, remove traces of oil;
7. apply a continuous pressure on the brake pedal for about five minutes ;
8. Finally, inspect brake lines and fittings for leaks ;

FRONT AXLE AND STEERING

! CAUTION !

Before maintenance, turn off all switches, set to neutral, set parking brake, remove the key, and raise the front end of the vehicle supporting it with two jack stands of adequate capacity

STEERING INSPECTION

- Check tire inflation pressure, suspension components, tie rods straightness, tie rod ends play (wear), play (wear) in wheel bearings, kingpins and bushings.

REPLACING & ADJUSTING THE STEERING GEAR

- Remove the pitman arm;
- The steering box makes 6.5 turns, center the steering gear (3.25 turns from either side);
- Align the front wheel straight. Install the pitman arm.

TOE-IN ADJUSTEMENT

- With the wheels in straight forward direction, measure the inside (left to right) distance between the front tires, at the front and rear of the tires;
- Turn the rear tie rod until the distances are equal and tighten the two lock nuts on the tie rod.

REMOVING & GREASING OF FRONT HUBS, required once-a-year

- Remove dust cap and cutter pin, unscrew nut, remove hub;
- Inspect bearings and races for wear and replace worn bearings;
- Replace the seal;
- Pack the hub with wheel bearing grease and re-assemble.

ADJUSTING FRONT HUBS

- Tighten spindle nut to 30 ft-lb to seat the bearing and back off the nut to the next slot;
- Install a new cutter pin and the dust cap.

BATTERY MAINTENANCE

! WARNING !

- It is the responsibility of the owner of this vehicle to ensure that the service technicians are properly trained, read and obey the safety rules and guidelines in this manual (ANSI B56).
- Maintenance operations must be made by properly trained service technicians only.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all the switches, set to neutral, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity.
- Keep charger disconnected while doing any maintenance work.
- Always wear a face shield and scarf when working around batteries.
- Battery emits highly explosive gases; do not produce sparks to avoid battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.
- Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.
- Use two counteracting tools, double-wrench technique, when disconnecting or tightening battery posts.
- Before cleaning or replacing a battery, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-, identify battery polarity and disconnect battery leads.
- After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

BATTERY LEADS AND CONNECTORS

Check for loose connections, damaged cables, acid spill, loose terminal posts, quarterly.

BATTERY POST CORROSION

If corrosion is present on battery posts, remove the cable connectors, use a wire brush to remove particles, and then clean them with a cloth that has been moistened with ammonia.

ELECTROLYTE LEVEL

Does not apply to sealed battery.

- Disconnect battery connectors on roll-out or lift-out installations.
- Make sure the battery roll-out tray is provided with stops before rolling out.
- Fill with distilled water.
- Daily charged batteries normally require watering once a week. Under watering leads to a shortened battery life. Over watering leads to battery corrosion. Be careful not to overfill any cell to avoid electrolyte to be forced out while charging.
- Fill each cell to plate level with distillated or de-ionized water, before battery charging. When the battery is charged, the fluid expands and can seep out if overfilled. Refill each cell after full charge, when the fluid has expanded to its maximum level.
- Reinstall battery caps before charging.

BATTERY MOUNTING

A loose battery increases damaging effects of vibrations and is more prone to short out.

BATTERY DISCHARGE LIMIT

Discharging below a 20% state of charge cuts down the battery life and the number of cycles available. At 20% state of charge, specific gravity of 6V battery should be 1180; and 1220 for industrial battery.

CHARGING AREA

- Always charge battery in a well ventilated area set for and approved for charging.
- Never leave a charger connected for more than 20 hours.

FREQUENCY OF CHARGE

- When a battery is discharged to its 20% state of charge, it is best to charge immediately.
- Batteries require a low current equalization charge (min 4 hours) at least every week, to equalize battery cells, improve battery performance and life in number of cycles.
- Never leave a charger connected for more than 20 hours.

STORAGE

- Keep the battery from getting cold, it would loose its capacity.
- Let the battery warm up before charging.
- Charge batteries in “stored” vehicles every month.

DEFECTIVE BATTERY

Check specific gravity of each cell; if a cell is shorted, voltage drop may occur only when there is current.

BATTERY CHARGER

! WARNING !

Always unplug the AC and DC electrical cords before attempting any repairs to the charger.

CHARGER DOES NOT TURN ON:

- Dc cord of portable chargers must be disconnected from batteries after every charge to restart;
- Check dc fuse links;
- Check battery voltage at the battery connector;
- Check ac outlet and cordset;
- Replace electronic control ;

RELAY CLOSES AND TRANSFORMER HUMS BUT AMMETER DOES NOT REGISTER:

- Check dc fuse links;
- Check the continuity of the dc output cord, ammeter, diodes and all connections in the dc circuit;
- Check diodes;
- Check capacitor(rapidely increasing resistance);

SINGLE CHARGER FUSE BLOWS:

- Disconnect and check diodes;

BOTH FUSE LINKS BLOW:

- Check the battery pack and battery connector polarity;
- Disconnect and check diodes.

CHARGER OUTPUT IS LOW:

- Disconnect and check diodes;
- Can be caused by a transformer failure.

AMMETER READS 30 AMPS FOR MORE THAN 30 MINUTES:

- Check the battery pack;

CHARGER DOES NOT TURN OFF:

- Check specific gravity in each battery cell;
- As much as 16 hours may be required to properly charge heavely discharged new or cold batteries;
- Replace electronic control.

AC LINE FUSE OR CIRCUIT BREAKER BLOWS:

- Check ac cordset;
- Check ac line fuse rating;
- Replace electronic control;
- Can be caused by a transformer failure.

ELECTRICAL TROUBLESHOOTING

! WARNING !

Maintenance work must be performed by trained service technicians only.

It is the responsibility of the owner of this vehicle to ensure that the services technicians are properly trained, understand and obey the safety rules and guidelines (ANSI B56).

All service technicians must read and understand the maintenance warning section in this manual.

! WARNING !

Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground, secure with jack stands of adequate capacity, disconnect charger.

Always wear safety glasses.

Batteries emit highly explosive gases that can be ignited by a spark. Before disconnecting a high current terminal, turn off all switches, disconnect battery charger, disconnect batteries.

Keep clear from moving parts such as tires, sheaves and motor.

PMC SELF DIAGNOSTIC

If your PMC comes with a status led, use the flashing code to help troubleshooting.

BATTERY VOLTAGE

Make sure batteries are securely connected. Measure voltage between + and - terminals. We will call this value B+ or full battery voltage.

ACCESSORIES NOT WORKING

- Check the fuses on the batteries and the DC/DC converter.
- Check voltage across + and – terminals on the battery gage; if not B+, check wiring.
- Turn the key switch ON, check voltage between output terminal on the key switch and the - terminal on the battery gage; if not B+, replace the key switch.
- Check voltage across DC/DC converter output terminals; if not 12-Volt, replace the converter.
- Depress the accessory switch, check voltage across accessory terminals. If not 12-Volt, replace the switch. If 12-Volt, replace the accessory.

FORWARD ONLY

On a SEPEX motor control, check the reverse signal input on the controller.
On a series wound motor control, a bad reverse contactor is the most probable cause of the problem. Switch to reverse and check voltage on the reverse control wire. If not B+, replace the F/R switch. If B+, turn off the key switch, disconnect batteries, disconnect power terminals on the F/R contactors, check the resistance across N.C. power terminals of the reverse contactor. If not 0 ohm, change the reverse contactor. If 0 ohms, switch to forward and check the resistance across the forward N.O. power terminals. If not 0 ohms, change the forward contactor.

REVERSE ONLY

On a SEPEX motor control, check the forward signal input on the controller.
On a series wound motor control, a bad forward contactor is the most probable cause of the problem. Switch to forward and check the voltage on the forward control wire. If not B+, replace the F/R switch. If B+, turn off the key switch, disconnect batteries, disconnect power terminals on the F/R contactors, check the resistance across N.C. power terminals of the forward contactor. If not 0 ohm, change the forward contactor. If 0 ohms, switch to reverse and check the resistance across the reverse N.O. power terminals. If not 0 ohms, change the reverse contactor.

TRAVEL AT REDUCED SPEED

Check batteries.

Turn off all switches and disconnect charger. Wear face shield and gloves. Do not disturb any battery connection to avoid sparks. Check the specific gravity of each cell. Cold batteries, highly discharged batteries or dead cells are the most frequent causes of reduced travel speed.

Check potentiometer.

Turn off the key switch, disconnect potentiometer terminals. Check the resistance between terminals.

Other causes of lower speed:
- dragging brakes;
- cold temperature (higher differential oil viscosity).

INTERMITTENT OPERATION

A bad potentiometer is the most probable cause of the following:
- acceleration is not constant;
- maximum speed is erratic;
- sudden stop after a bump or shock;
- erratic starts, requiring several pedal cycles.

A bad F/R contactor is also a probable cause of the following:
- sudden stop after a bump or shock;
- would not start to move at times.

Erratic starts could also be the cause of a misadjusted potentiometer or micro-switch; the pot signal must be less than 50 ohms when the micro-switch turns on.

PMC has an HPD safety feature that prevents the vehicle from moving if the accelerator pedal is depressed before the key switch is ON and seat switch is activated.

PMC may also have an SRO safety feature that prevents the vehicle from moving if the F/R switch is activated before turning on the key switch and activating the seat switch.

The vehicle stops on a steep and long ramp or while towing a heavy load: the circuit breaker has open to prevent motor overheating and will reset automatically after one minute. The PMC is also equipped with an internal thermal protection that cutback the current until the PMC has cooled down.

NO MOTION

Make sure that the PMC surface is clean and dry; check the terminal areas. Dust Particles or acid contamination, can create current leaks and cause a PMC malfunction.

Check F/R switch

Turn on the key switch and set to forward. Check voltage between the forward terminal and the – terminal on the battery gage, check voltage between the reverse terminal and the – terminal on the battery gage; if both B+, replace the F/R switch.

Check switches and wiring

Disconnect control terminals on the PMC and check all control signals. If a switch pin does not read B+, check wiring or replace the switch.

Check potentiometer

Turn the key switch to OFF, disconnect potentiometer terminals. Check the resistance across terminals: if not within the recommended limits, adjust or replace the potentiometer. Check for shorts between potentiometer wires and vehicle frame; resistance should read at least 1 megohm.

Check main contactor or solenoid

Check voltage across power terminals; if not B+, check circuit breaker or replace the solenoid.
Turn to on the key switch and activate the seat switch. Check voltage across the coil terminals; if not B+, check wiring and interlock switches. Check resistance across power terminals; if not 0 ohms, replace the solenoid.

Check circuit breaker and SEPEX DIODE

Before replacing the circuit breaker, check for shorts in the power circuit and check the SEPEX diode in the power circuit using a diode tester. If no such instrument is at hand, use an ohmmeter: the reading should be weak in one direction and strong in the other way.
Check the resistance across the circuit breaker. If not 0 ohms, replace the circuit breaker.

Check PMC

First disconnect battery B+ and B-, then PMC B+ and M-. Check the internal diode between B+ and M- terminals using a diode tester. If no such instrument is at hand, use an ohmmeter: the reading should be weak in one direction and strong in the other way. If the internal diode is defective, the PMC must be replaced.

Check the Motor

First disconnect battery B+ and B-, disconnect power terminals and check the motor armature and field for opens.

SERIES SPEED CONTROLLER

MANUAL

1214-8
1215-8
1219-8

MultiMode™
MOTOR CONTROLLERS

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DESIGN OF CURTIS PMC 1200 SERIES CONTROLLERS PROTECTED BY U.S. PATENT NO. 4626750.

1214-8 / 1215-8 / 1219-8 Manual
p/n 16369, Rev. C: April 2003

CURTIS

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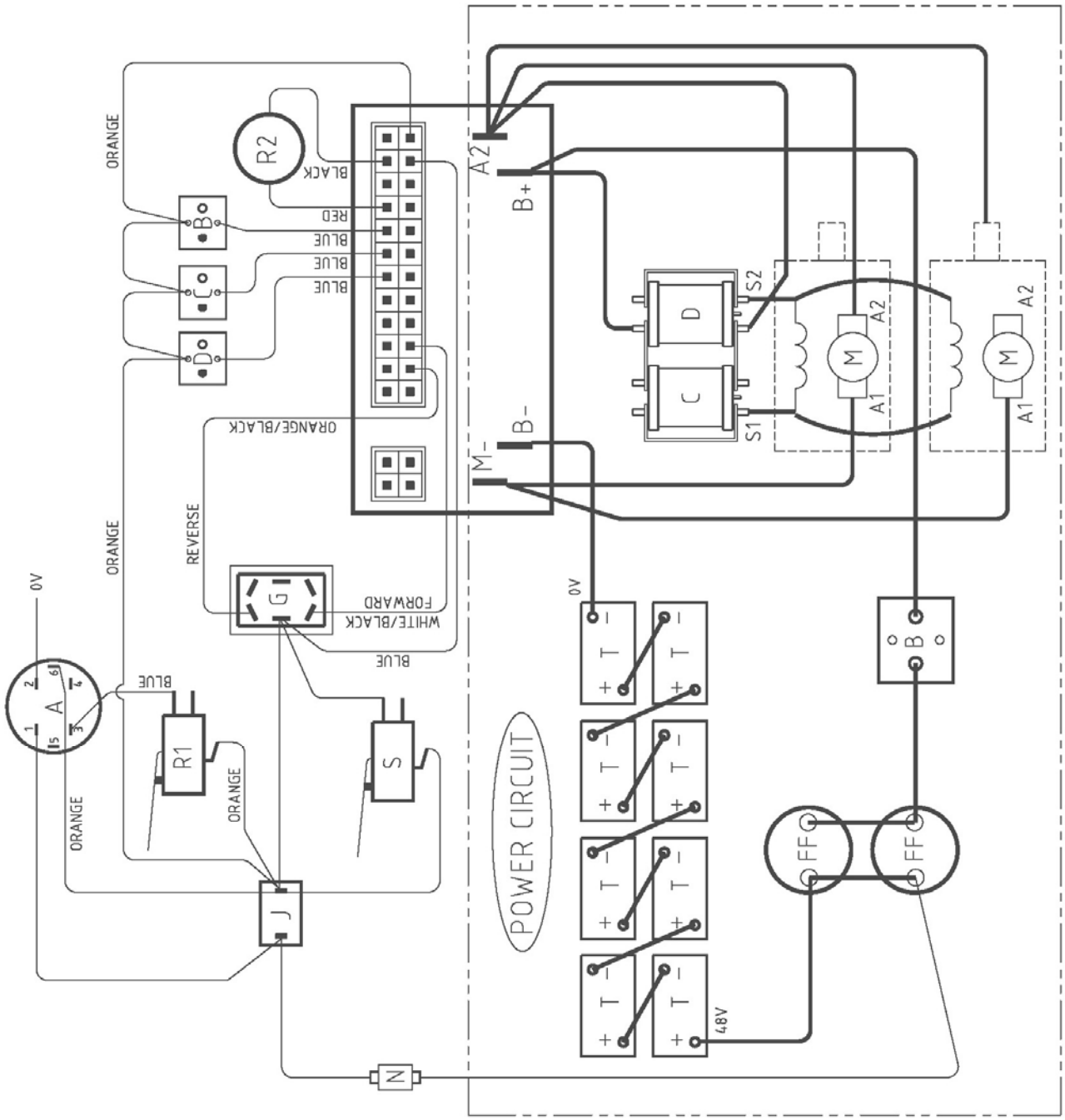
ELECTRICAL DIAGRAM
DIAGRAMME ÉLECTRIQUE



NO	DÉSIGNATION	REF	QTE
A	INDICATOR + HOUR METER	486201	1
B	SOLENOID	486222	1
C	FORWARD CONTACTOR	436218	1
D	REVERSE CONTACTOR	436217	1
E	EMERGENCY PUSH BUTTON	4869015	1
G	F/R SELECTOR	266211	1
J	IGNITION	246205	1
M	MOTOR	–	2
N	FUSE	246108	2
R1	MICRO-SWITCH, ACCELERATOR	367002	1
R2	POT	367003	1
S	SEATSWITCH	247002	1
T	BATTERY 6 VOLTS		8
U	SPEED CONTROL	1215-8306	1
FF	CIRCUIT BREAKER (CDLA 150)	2869001	2

PARAMETERS

EMR REV C / L	EMERGENCY REVERSE CURRENT LIMIT	20
THROTTLE TYPE	THROTTLE TYPE	3
RAMP SHAPE	THROTTLE MAP	30
CREEP SPEED	CREEP SPEED, AS PERCENT PWM DUTY CYCLE	0
EMR REV SPEED	EMR. REVERSE SPEED, AS % PWM DUTY CYCLE	25
SEQUENCING DLY	SEQUENCING DELAY, IN SECONDS	1.4
VARIABLE PLUG	THROTTLE-VAR. PLUG BRAKING: ON OR OFF	OFF
HIGH PEDAL DIS	HIGH PEDAL DISABLE (HPD): TYPE	1
SRO	STATIC RETURN TO OFF (SRO): TYPE	1
ANTI - TIEDOWN	ANTI - TIEDOWN: ON OR OFF	OFF
QUICK START	QUICK START THROTTLE FACTOR	3.0
M1 MAIN C / L	MODE 1 MAIN CURRENT LIMIT	500
M1 PLUG C / L	MODE 1 PLUG CURRENT LIMIT	200
M1 RAMP C / L	MODE 1 RAMP START CURRENT LIMIT	500
M1 ACCEL RATE	MODE 1 ACCELERATION RATE, IN SECONDS	1.5
M1 MAX SPEED	MODE 1 MAX SPEED, AS % PWM OUTPUT	100
M2 MAIN C / L	MODE 2 MAIN CURRENT LIMIT	500
M2 PLUG C / L	MODE 2 PLUG CURRENT LIMIT	200
M2 RAMP C / L	MODE 2 RAMP START CURRENT LIMIT	500
M2 ACCEL RATE	MODE 2 ACCELERATION RATE, IN SECONDS	1.5
M2 MAX SPEED	MODE 2 MAX SPEED, AS % PWM OUTPUT	100
NEUT BRAKE C / L	NEUT BRAKE CURRENT LIMIT	200
NEUTRAL BRAKE	NEUTRAL BRAKE: ON OR OFF	ON

MOTREC INC.

TITRE DIAGRAM ELECTRIC T-448/E-660/T-848
500 AMP PMC CONTROLLER

DESSINE: C.L. DATE: 08/06/00

CURTIS SPEED CONTROLLER

MANUAL

CURTIS PMC

MODEL **1244**

MultiMode™
MOTOR CONTROLLER

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DESIGN OF CURTIS PMC 1200 SERIES CONTROLLERS PROTECTED BY U.S. PATENT NO. 4626750.

1244 Manual, p/n 16958
Rev. B: January 2001

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1244 Manual
p/n 16958, Rev. B: January 2001

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WIRING: Standard Configuration

Figure 3 shows the typical wiring configuration for most applications. The interlock switch is typically a seat switch, tiller switch, or foot switch.

Standard Power Wiring

Motor armature winding is straightforward, with the armature's A1 connection going to the controller's B+ bus bar and the armature's A2 connection going to the controller's M- bus bar.

The motor's field connections (**F1** and **F2**) to the controller are less obvious. The direction of vehicle travel with the forward direction selected will depend on

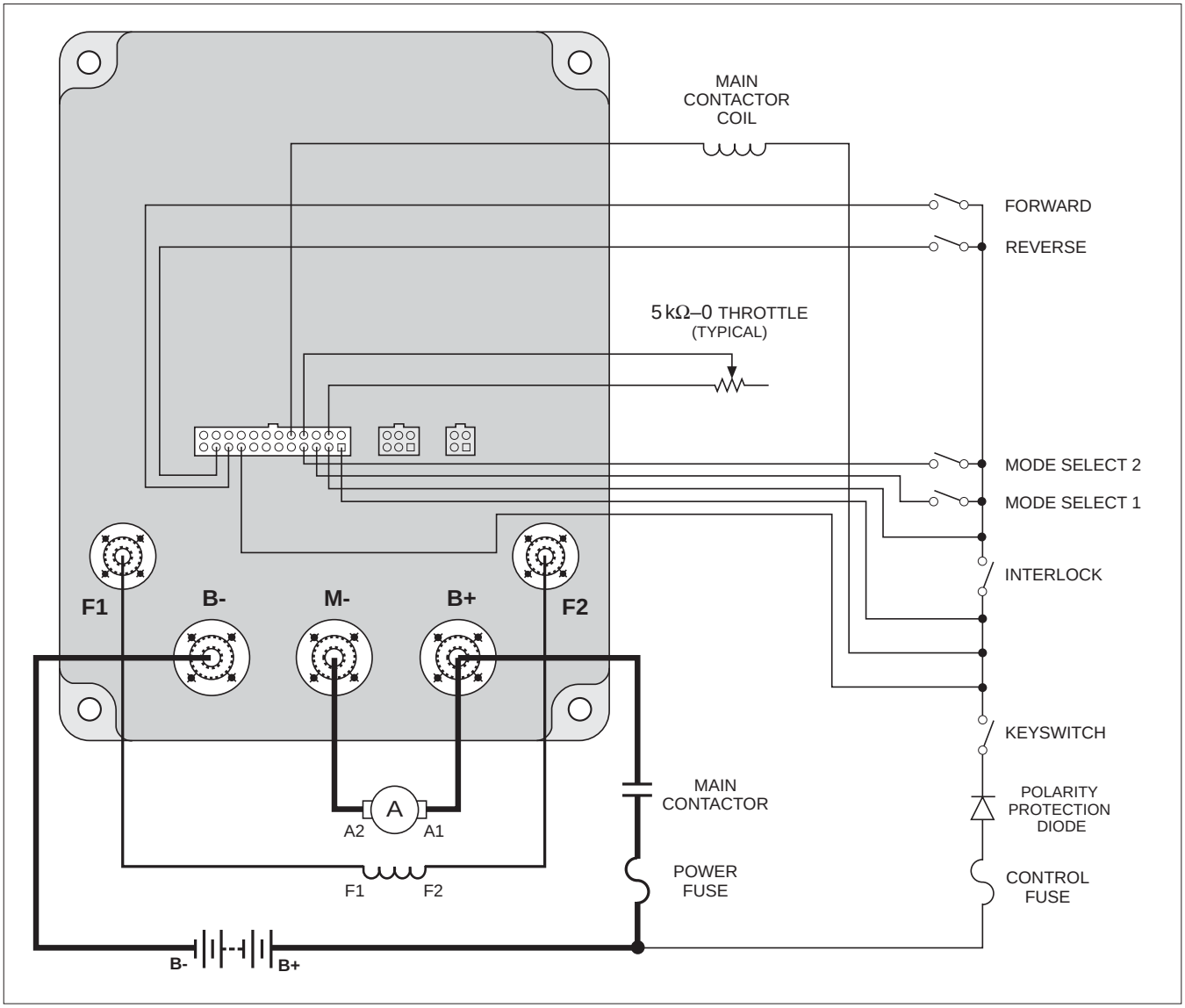


Fig. 3 *Standard wiring configuration, Curtis PMC 1244 controller.*

8 DIAGNOSTICS AND TROUBLESHOOTING

The 1244 controller provides diagnostics information to assist technicians in troubleshooting drive system problems. The diagnostics information can be obtained by observing the appropriate display on the handheld programmer, the fault codes issued by the Status LED, or the fault display driven by the controller's Fault 1 and Fault 2 outputs. Refer to the troubleshooting chart (Table 5) for suggestions covering a wide range of possible faults.

PROGRAMMER DIAGNOSTICS

The programmer presents complete diagnostic information in plain language. Faults are displayed in the Diagnostic Menu (see column 2 in the troubleshooting chart), and the status of the controller inputs/outputs is displayed in the Test Menu.

Accessing the Diagnostic History Menu provides a list of the faults that have occurred since the diagnostic history file was last cleared. Checking (and clearing) the diagnostic history file is recommended each time the vehicle is brought in for maintenance.

The following 4-step process is recommended for diagnosing and troubleshooting an inoperative vehicle: (1) visually inspect the vehicle for obvious problems; (2) diagnose the problem, using the programmer; (3) test the circuitry with the programmer; and (4) correct the problem. Repeat the last three steps as necessary until the vehicle is operational.

Example: A vehicle that does not operate in "forward" is brought in for repair.

STEP 1: Examine the vehicle and its wiring for any obvious problems, such as broken wires or loose connections.

STEP 2: Connect the programmer, select the Diagnostics Menu, and read the displayed fault information. In this example, the display shows "No Known Faults," indicating that the controller has not detected anything out of the norm.

STEP 3: Select the Test Menu, and observe the status of the inputs and outputs in the forward direction. In this example, the display shows that the forward switch did not close when "forward" was selected, which means the problem is either in the forward switch or the switch wiring.

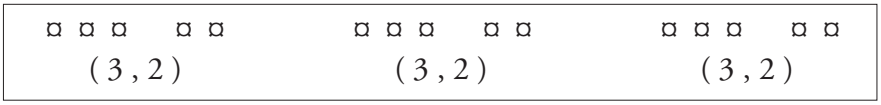
STEP 4: Check or replace the forward switch and wiring and repeat the test. If the programmer shows the forward switch closing and the vehicle now drives normally, the problem has been corrected.

Table 5 TROUBLESHOOTING CHART

LED CODE	PROGRAMMER LCD DISPLAY	FAULT CATEGORY	EXPLANATION	POSSIBLE CAUSE
1,2	HW FAILSAFE1-2-3	1	self-test or watchdog fault	1. Controller defective.
1,3	M- SHORTED	1	internal M- short to B-	1. Controller defective.
	FIELD OPEN	1	field winding fault	1. Motor field wiring loose. 2. Motor field winding open.
	ARM SENSOR	1	armature current sensor fault	1. Controller defective.
	FLD SENSOR	1	field current sensor fault	1. Controller defective.
2,1	THROTTLE FAULT 1	1	wiper signal out of range	1. Throttle input wire open. 2. Throttle input wire shorted to B+ or B-.
	THROTTLE FAULT 2	1	pot low fault	1. Throttle pot defective. 2. Wrong throttle type selected.
2,2	SRO	3	SRO fault	1. Improper sequence of KSI, interlock, and direction inputs. 2. Wrong SRO type selected. 3. Interlock or direction switch circuit open. 4. Sequencing delay too short.
2,3	HPD	3	HPD fault	1. Improper seq. of direction and throttle inputs. 2. Wrong HPD type selected. 3. Misadjusted throttle pot. 4. Sequencing delay too short.
2,4	BB WIRING CHECK	1	emergency reverse wiring fault	1. Emergency reverse wire open. 2. Emergency reverse check wire open.
3,1	CONT DRVR OC	1	cont. driver output overcurrent	1. Contactor coil shorted.
3,2	MAIN CONT WELDED	1	welded main contactor	1. Main contactor stuck closed. 2. Main contactor driver shorted.
3,3	PRECHARGE FAULT	1	internal voltage too low at startup	1. Controller defective. 2. External short, or leakage path to B- on external B+ connection.
3,4	MISSING CONTACTOR	1	missing contactor	1. Any contactor coil open or not connected.
	MAIN CONT DNC	1	main contactor did not close	1. Main contactor missing or wire to coil open.
4,1	LOW BATTERY VOLTAGE	2	low battery voltage	1. Battery voltage <undervoltage cutback limit. 2. Corroded battery terminal. 3. Loose battery or controller terminal.
4,2	OVERVOLTAGE	2	overvoltage	1. Battery voltage >overvoltage shutdown limit. 2. Vehicle operating with charger attached. 3. Battery disconnected during regen braking.
4,3	THERMAL CUTBACK	2	over-/under-temp. cutback	1. Temperature >85°C or < -25°C. 2. Excessive load on vehicle. 3. Improper mounting of controller. 4. Operation in extreme environments.
4,4	ANTI-TIEDOWN	3	Mode 2 or Mode 4 selected at startup	1. Mode switches shorted to B+. 2. Mode switches “tied down” to select Mode 2 or Mode 4 permanently.

LED DIAGNOSTICS

A Status LED is built into the 1244 controller. It is visible through a window in the label on top of the controller. This Status LED displays fault codes when there is a problem with the controller or with the inputs to the controller. During normal operation, with no faults present, the Status LED flashes steadily on and off. If the controller detects a fault, a 2-digit fault identification code is flashed continuously until the fault is corrected. For example, code "3,2"—welded main contactor—appears as:



The codes are listed in Table 6.

Table 6 STATUS LED FAULT CODES

LED CODES		EXPLANATION
LED off	▬▬▬	no power or defective controller
solid on	▭	controller or microprocessor fault
0,1	■ ¤	controller operational; no faults
1,1	¤ ¤	[not used]
1,2	¤ ¤¤	hardware failsafe fault
1,3	¤ ¤¤¤	M-, current sensor, or motor fault
1,4	¤ ¤¤¤¤	[not used]
2,1	¤¤ ¤	throttle fault
2,2	¤¤ ¤¤	static return to off (SRO) fault
2,3	¤¤ ¤¤¤	high pedal disable (HPD) fault
2,4	¤¤ ¤¤¤¤	emergency reverse circuit check fault
3,1	¤¤¤ ¤	contactor driver overcurrent
3,2	¤¤¤ ¤¤	welded main contactor
3,3	¤¤¤ ¤¤¤	precharge fault
3,4	¤¤¤ ¤¤¤¤	missing contactor, or main cont. did not close
4,1	¤¤¤¤ ¤	low battery voltage
4,2	¤¤¤¤ ¤¤	overvoltage
4,3	¤¤¤¤ ¤¤¤	thermal cutback, due to over/under temp.
4,4	¤¤¤¤ ¤¤¤¤	anti-tiedown fault

NOTE: Only one fault is indicated at a time, and faults are not queued up. Refer to the troubleshooting chart (Table 5) for suggestions about possible causes of the various faults.

PROGRAMMING PARAMETERS – E-480TT, T-448HD

! WARNING !

The owner of this vehicle shall ensure that the service technicians are qualified, properly trained and obey the safety rules and guidelines in OSHA and ANSI B56 regulations, and in this manual.

Before installing and/or programming the PMC, park the vehicle on a flat level surface, lift the wheels off the ground and secure with jack stands of adequate capacity. Don't connect charger.

Programmable controllers must be programmed using the parameter settings in this service manual, before connecting the motor, to avoid sudden vehicle movement and accident.

Do not try to increase motor speed by changing parameter settings in the speed controller; it can cause accident and severe damage to the motor.

VOLTAGE	NOMINAL BATTERY VOLTAGE, IN VOLTS	4
M1 DRIVE C/L	MODE 1 DRIVE CURRENT LIMIT, IN AMPS	500
M2 DRIVE C/L	MODE 2 DRIVE CURRENT LIMIT, IN AMPS	500
M3 DRIVE C/L	MODE 3 DRIVE CURRENT LIMIT, IN AMPS	500
M4 DRIVE C/L	MODE 4 DRIVE CURRENT LIMIT, IN AMPS	500
M1 BRAKE C/L	MODE 1 BRAKING CURRENT LIMIT, IN AMPS	200
M2 BRAKE C/L	MODE 2 BRAKING CURRENT LIMIT, IN AMPS	200
M3 BRAKE C/L	MODE 3 BRAKING CURRENT LIMIT, IN AMPS	200
M4 BRAKE C/L	MODE 4 BRAKING CURRENT LIMIT, IN AMPS	200
M1 THRT BRK %	MODE 1 THROT. BRAKING, AS % OF BRAKE C/L	100
M2 THRT BRK %	MODE 2 THROT. BRAKING, AS % OF BRAKE C/L	100
M3 THRT BRK %	MODE 3 THROT. BRAKING, AS % OF BRAKE C/L	100
M4 THRT BRK %	MODE 4 THROT. BRAKING, AS % OF BRAKE C/L	100
M1 ACCEL RATE	MODE 1 ACCELERATION RATE, IN SEC.	4
M2 ACCEL RATE	MODE 2 ACCELERATION RATE, IN SEC.	4
M3 ACCEL RATE	MODE 3 ACCELERATION RATE, IN SEC.	4
M4 ACCEL RATE	MODE 4 ACCELERATION RATE, IN SEC.	4
DECEL RATE	DECELERATION RATE, IN SEC.	2.5
M1 BRAKE RATE	MODE 1 BRAKING RATE, IN SEC.	3
M2 BRAKE RATE	MODE 2 BRAKING RATE, IN SEC.	3
M3 BRAKE RATE	MODE 3 BRAKING RATE, IN SEC.	3
M4 BRAKE RATE	MODE 4 BRAKING RATE, IN SEC.	3
QUICK START	QUICK START THROTTLE FACTOR	4
TAPER RATE	Regen brak. Decrease rate when apporch. 0spd, 1/32s	32
M1 MAX SPEED	MODE 1 MAX. SPEED, AS % PWM OUTPUT	40
M2 MAX SPEED	MODE 2 MAX. SPEED, AS % PWM OUTPUT	100
M3 MAX SPEED	MODE 3 MAX. SPEED, AS % PWM OUTPUT	40
M4 MAX SPEED	MODE 4 MAX. SPEED, AS % PWM OUTPUT	40
M1 CREEP SPEED	MODE 1 CREEP SPEED, AS % PWM OUTPUT	0
M2 CREEP SPEED	MODE 2 CREEP SPEED, AS % PWM OUTPUT	0
M3 CREEP SPEED	MODE 3 CREEP SPEED, AS % PWM OUTPUT	0
M4 CREEP SPEED	MODE 4 CREEP SPEED, AS % PWM OUTPUT	0
REGEN SPEED	Min. speed for regen braking, as % of vehicle speed	20
CTRL MODE	CONTROL MODE	1
THROTTLE TYPE	THROTTLE TYPE	3

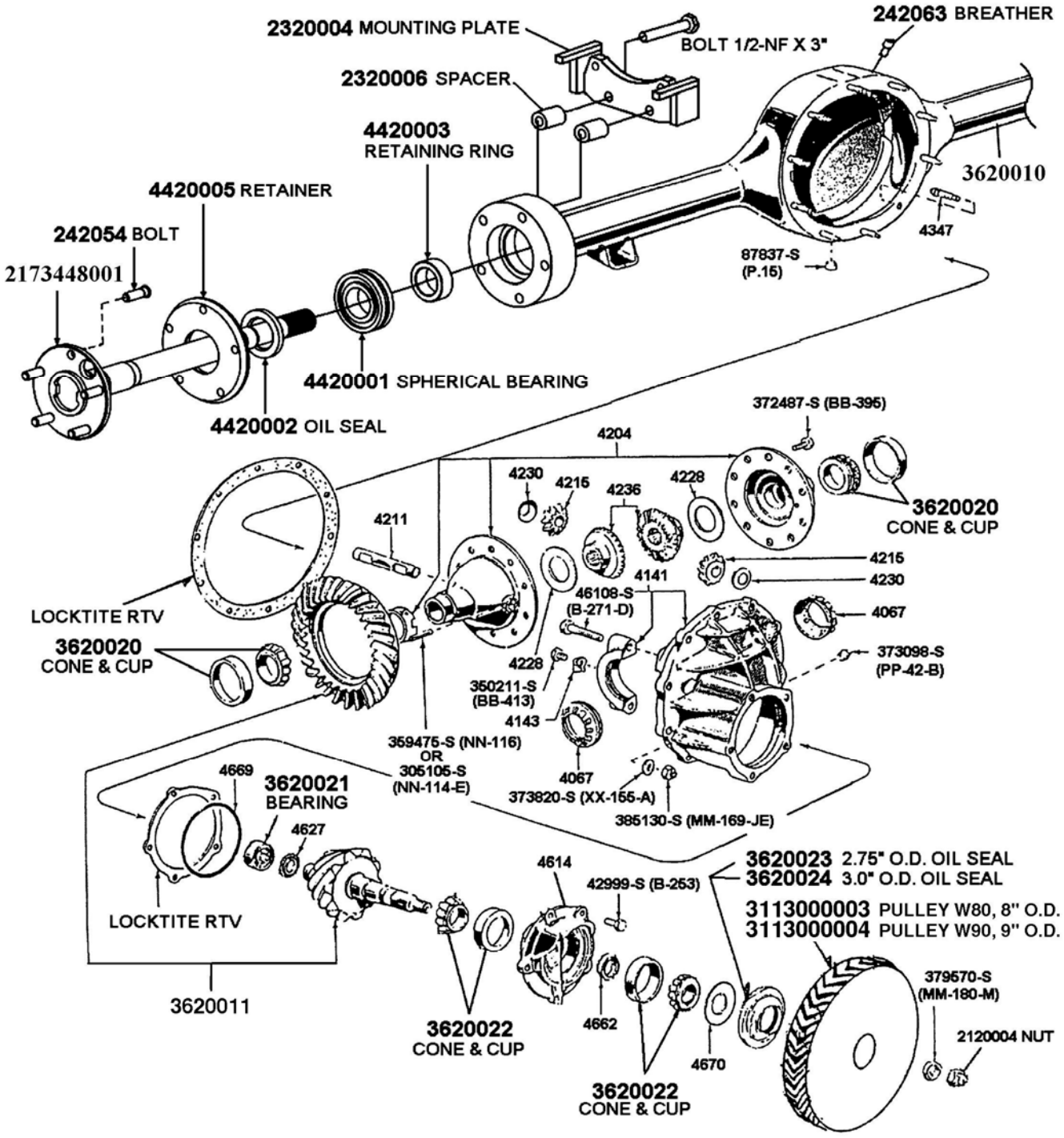
THRO. DEADBAND	Thr. Neutral deadband % of 5kohms pot	6
THROTTLE MAX	Thr. Input req`d for 100%PWM %5kohm pot	90
M1 THRTL MAP	MODE 1 THROTTLE MAP, AS %	30
M2 THRTL MAP	MODE 2 THROTTLE MAP, AS %	30
M3 THRTL MAP	MODE 3 THROTTLE MAP, AS %	30
M4 THRTL MAP	MODE 4 THROTTLE MAP, AS %	30
FIELD MIN	MIN. FIELD CURRENT, IN AMPS	8.5
FIELD MAX	MAX. FIELD CURRENT, IN AMPS	30
FIELD MAP START	Armature current at wich FIELD MAP takes effect, amps	150
FIELD MAP	Field Winding Current, as % of Armature Current	50
CURRENT RATIO	CURRENT RATIO:FACTOR OF 1, 2, 4 OR 8	2
RESTRAINT	RAMP RESTRAINT: 1 TO 10	3
LOAD COMP	LOAD COMPENSATION: 0 TO 25	0
HPD	HIGH PEDAL DISABLE (HPD) TYPE	2
SRO	STATIC RETURN TO OFF (SRO) TYPE	1
SEQUENCING DLY	SEQUENCING DELAY, IN SEC.	1
MAIN CONT INTR	MAIN CONTACTOR INTERLOCK: ON OR OFF	ON
MAIN OPEN DELAY	MAIN CONTACTOR DROPOUT DELAY, IN SEC.	1
WELD CHECK	MAIN CONTACTOR WELD CHECK: ON OR OFF	ON
MAIN CHECK	MAIN COIL OPEN CHECK: ON OR OFF	ON
AUX ENABLE	AUXILIARY ENABLE: ON OR OFF	OFF
EM BRAKE	ELECTROMAGNETIC BRAKE ON OR OFF	OFF
AUX DELAY	AUXILIARY DRIVER DROPOUT DELAY, IN SEC.	0
AUX CHECK	AUXILIARY COIL OPEN CHECK: ON OR OFF	OFF
EM BRAKE DELAY	ELECTROMAGNETIC BRAKE DELAY, IN SEC.	0
EM BRAKE CHECK	ELECTROMAG. BRAKE OPEN CHECK: ON OR OFF	OFF
REV DRVR CHECK	REVERSE SIGNAL OPEN CHECK: ON OR OFF	OFF
CONT PULL IN	CONTACTOR COIL PULL-IN VOLTAGE, AS %	100
CONT HOLDING	CONTACTOR HOLDING VOLTAGE, AS %	100
EMR REV ENABLE	EMERGENCY REVERSE FUNCTION : ON OR OFF	OFF
EMR REV C/L	EMERGENCY REVERSE CURRENT LIMIT, IN AMPS	50
EMR REC CHECK	EMERGENCY REV. WIRING CHECK : ON OR OFF	OFF
ANTI-TIEDOWN	ANTI-TIEDOWN: ON OR OFF	OFF
FAULT CODE	ON OR OFF	ON
PEDAL INTERLOCK	THREADLE, PB-6, CHECK WIRING	OFF
PRECHARGE	ON OR OFF	ON

SPARE PARTS

BODY

REF.	*PART NO*	*DESCRIPTION*
1	2382320009	SEAT BACK CUSHION
	2383320004	SEAT CUSHION
	1005003	BUCKET SEAT ON SLIDE ADJUSTER (NOT ILLUSTRATED)
2	2384300009	BACKREST FRAME
3	4400007	BATTERY COVER
4	2330448002	MOTOR COVER
5	2339448004	CONTROLS COVER
6	300022	5.7X8 LRD WHEEL
	300024H	5.7X8 NSH, TITAN PREMIUM, WHEEL
	2223360001	5.00 X 8 SOLID, SOFT RUBBER, WHEEL
7	2314320001	FRONT BUMPER
8	120003	TRIMMING
9	2803300008	RIGHT HANDLE
	2803300009	LEFT HANDLE

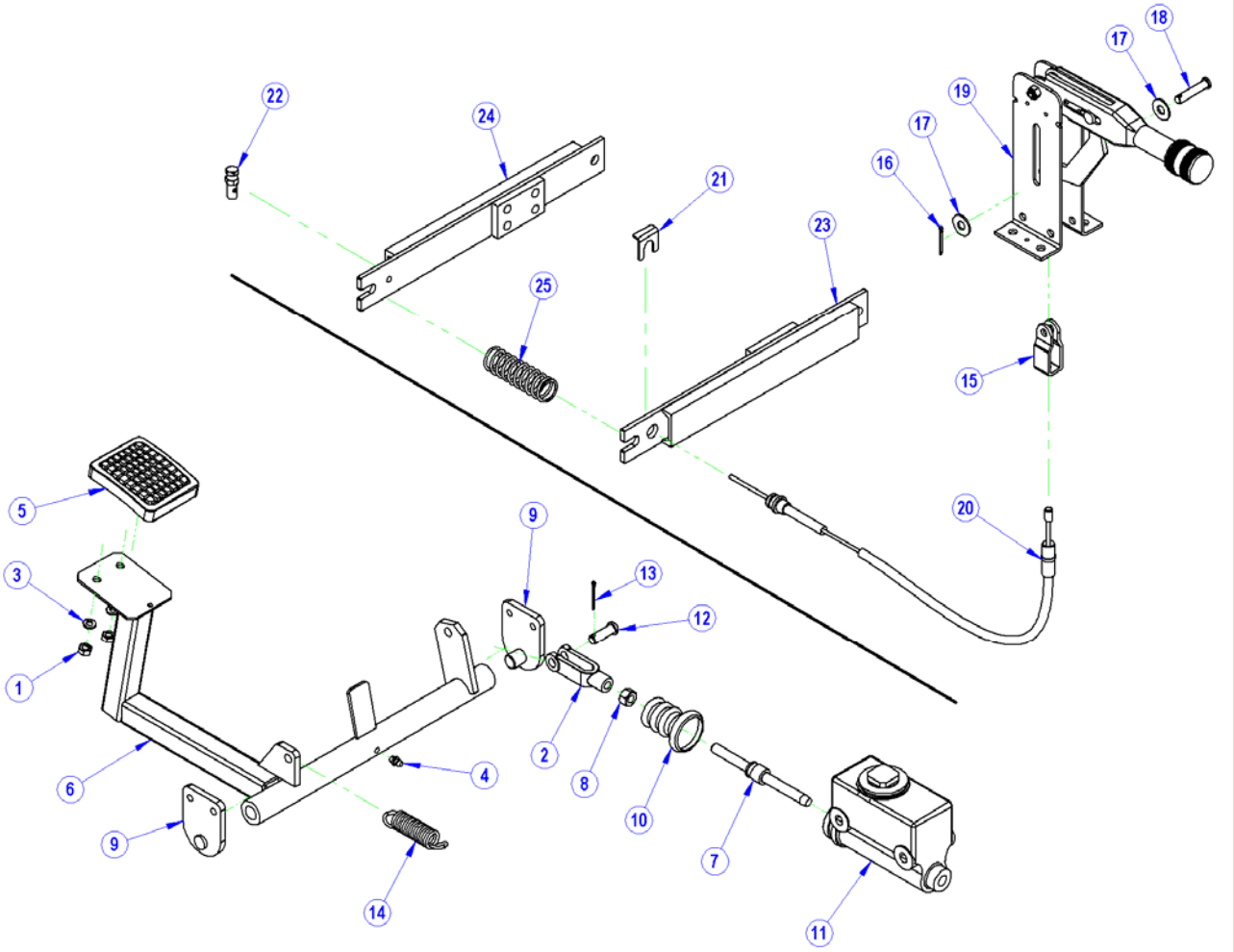
FORD F-150 DIFFERENTIAL



FORD WEC (NON-LOCKING) REAR AXLE SERVICE PARTS LIST NO. 237

QTY.	PART NUMBER		DESCRIPTION
1	373098-S100 (PP-42-B)		Plug (housing)-1/2"-14
1	E3AZ	4033-A	Cover assy. (housing)-also serviced in assy.-group 4010
		4036	Gasket (cover to housing)-use D8AZ 19562-B
		4067	Shim (differential bearing adjustment)
AR	D9AZ	4067-A	.241" thick
AR	D9AZ	4067-B	.243" thick
AR	D9AZ	4067-C	.245" thick
AR	D9AZ	4067-D	.247" thick
AR	D9AZ	4067-E	.249" thick
AR	D9AZ	4067-F	.251" thick
AR	D9AZ	4067-G	.253" thick
AR	D9AZ	4067-H	.255" thick
AR	D9AZ	4067-J	.257" thick
AR	D9AZ	4067-K	.259" thick
AR	D9AZ	4067-L	.261" thick
AR	D9AZ	4067-M	.263" thick
AR	D9AZ	4067-N	.265" thick
AR	D9AZ	4067-P	.267" thick
AR	D9AZ	4067-R	.269" thick
AR	D9AZ	4067-S	.271" thick
AR	D9AZ	4067-T	.273" thick
AR	D9AZ	4067-U	.275" thick
AR	D9AZ	4067-V	.277" thick
AR	D9AZ	4067-W	.279" thick
AR	D9AZ	4067-X	.281" thick
AR	D9AZ	4067-Y	.283" thick
AR	D9AZ	4067-Z	.285" thick
AR	D9AZ	4067-AA	.287" thick
AR	D9AZ	4067-AB	.289" thick
AR	D9AZ	4067-AC	.291" thick
AR	D9AZ	4067-AD	.293" thick
AR	D9AZ	4067-AE	.295" thick
AR	D9AZ	4067-AF	.297" thick
1	E7TZ	4236-A	Gear kit (differential side)-use with axle #720C,724S,730D-1987/ Consists of 2-E7TZ 4228-A Washer 2-E7TW 4236-AA Gear
2	C7AZ	4N237-A	"U" washer (axle shaft retaining)
1	D8BZ	4241-A	Pin (differential pinion shaft lock)
2	C7AZ	4A332-A	"O" ring (axle shaft)
		4346	Bolt (housing cover)-self-locking-5/16"-18 x 5/8"-also serviced in assy.-group 4010
10	E6TZ	4346-A	Use with axle #WEC-A,B,720C,724S,730D,760B, 762T
8	E6TZ	4346-A	Use with axle #760C,762P
2	E5TZ	4346-A	Stud (housing cover)-5/16"-18 and-5/16"-18 x 1 1/2" long-also serviced in assy.-group 4010-use with axle #760C,762P
1	B7A	4616-A	Cup (driving pinion bearing front)-#88048
1	B7A	4621-A	Cone and roller (drive pinion front bearing)-#M88048
		4067	Shim (differential bearing adjustment) — Cont'd
AR	D9AZ	4067-AG	.299" thick
AR	D9AZ	4067-AH	.301" thick
AR	D9AZ	4067-AJ	.303" thick
AR	D9AZ	4067-AK	.305" thick
AR	D9AZ	4067-AL	.307" thick
		4200	Differential assy.-refer to group in Section 40
		4204	Case assy. (differential)
1	E7TZ	4204-E	Use with axle #720C,724S,730D-1987/
1	E7TZ	4211-A	Shaft (differential pinion kit)-use with axle #720C,724S,730D-1987/ Consists of 1-E7TW 4211-AA Shaft 1-D8BZ 4241-A Pin
1	E7TZ	4215-A	Pinion kit-use with axle #720C,724S, 730D-1987/ Consists of 2-E7TW 4215-AA Pinion 2-E7TZ 4230-A Washer
10	D5AZ	4216-A	Bolt (differential case)-self-locking-7/16"-20 x 3/4"
2	B7A	4221-B	Cone and roller (differential bearing)-#LM603049
2	D9AZ	4222-A	Cup (differential bearing)-#LM603012
		4228	Washer (differential side gear thrust)-also serviced in kit-group 4236
2	E7TZ	4228-A	Use with axle #720C,724S,730D-1987/
		4230	Washer (differential pinion thrust)-also serviced in kit-group 4215
2	E7TZ	4230-A	Use with axle #720C,724S,730D-1987/
1	C7AZ	4628-A	Cup (driving pinion bearing-rear)-#M802011
1	C7AZ	4630-A	Cone and roller (drive pinion rear bearing)-#M802048
1	B7A	4662-A	Spacer (driving pinion bearing)-1 5/16" I.D. x 15/32" long-collapsible-also serviced in kit-group 4209
		4663	Shim (pinion bearing)-serviced only in kit-group 4209
1	D5AZ	4670-A	Slinger (pinion shaft oil)
1	E5DZ	4676-A	Seal assy. (drive pinion oil)-#E5DW 4676-AA
		4851	Flange assy. (universal joint)-axle end
1	E7UZ	4851-A	1330 size-1987/
1	389546-S100 (MM-170-A)		Locknut and washer assy. (flange to pinion)-3/4"-20-also serviced in kit-group 4209
		4859	Deflector (driving pinion oil seal)
1	E6TZ	4859-A	Plastic-"From 1/86"-1986/

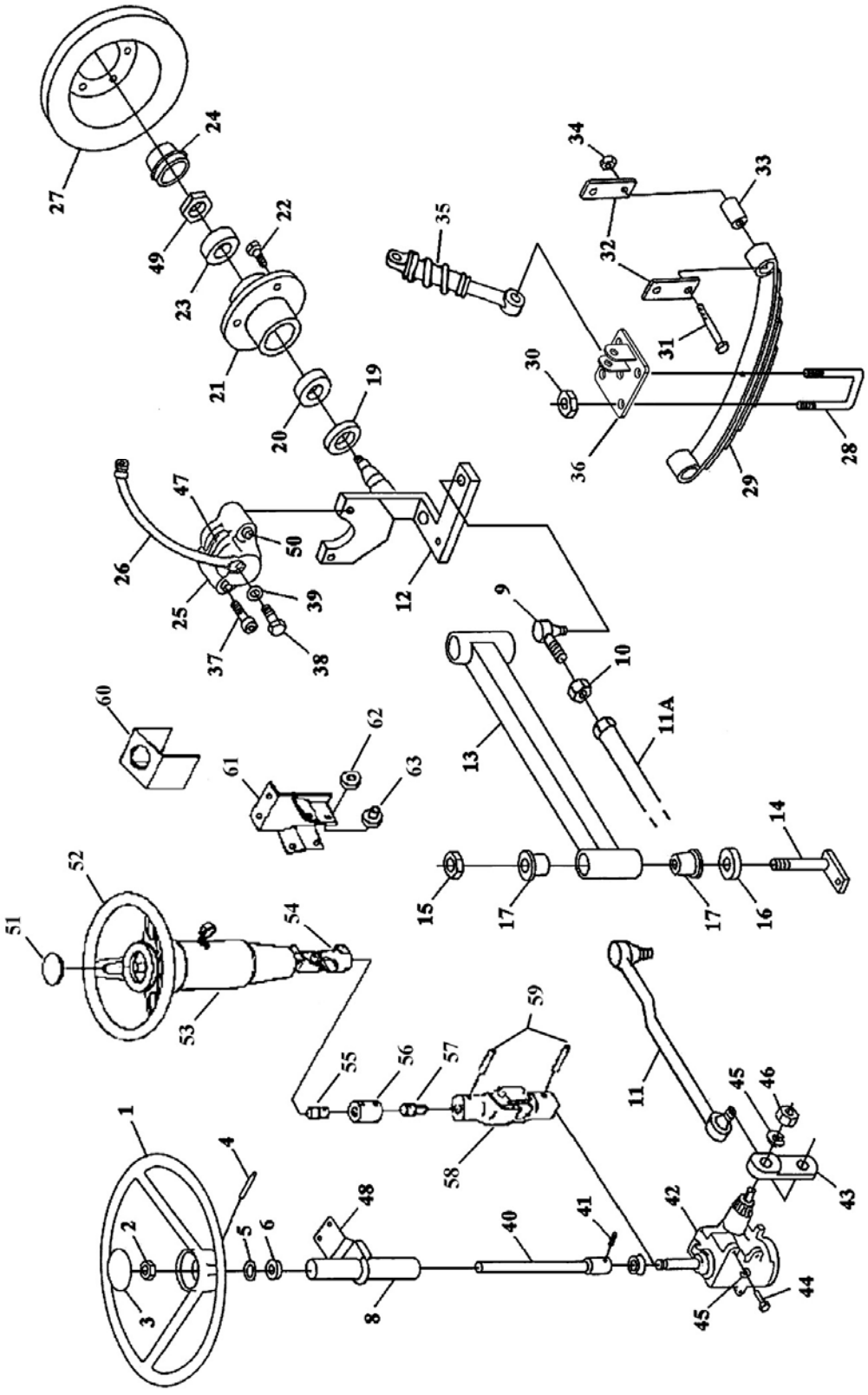
BRAKE CONTROLS



REF	*PART NO*	*DESCRIPTION*	*QTY*	*REF*	*PART NO*	*DESCRIPTION*	*QTY*
1		Nut 1/4-20UNC	1	14	2190000003	Spring (Extention)	1
2	2910000015	Yoke	1	15	2910000012	Yoke	1
3		Lock washer ¼	1	16		Cotter pin 3/32 x 1	1
4	2930000012	Lubrication fitting	1	17		Flat washer 5/16	2
5	2131100002	Rubber pad	1	18		Clevis pin 5/16 x 1-1/2	1
6	2131360002	Lever	1	19	2139240002	Handbrake lever	1
6	2131360012	Lever	1	20	2129000003	Handbrake cable	1
7	2133280001	Push rod-Master cylinder	1	21	2129000001	Clip	1
8		Nut 3/8-16UNF	1	22	2921000001	Cable stop	1
9	2132320001	Pivot	2	23	2127000006	Handbrake band (side cable)	1
10		Boot, included with #2125000001	1	24	2127000001	Handbrake band	1
11	2125000001	Master cylinder	1	25	2191240002	Spring (compression)	1
12		Clevis pin 3/8 x 1-3/32	1				
13		Cotter pin 3/32 x 1	1				

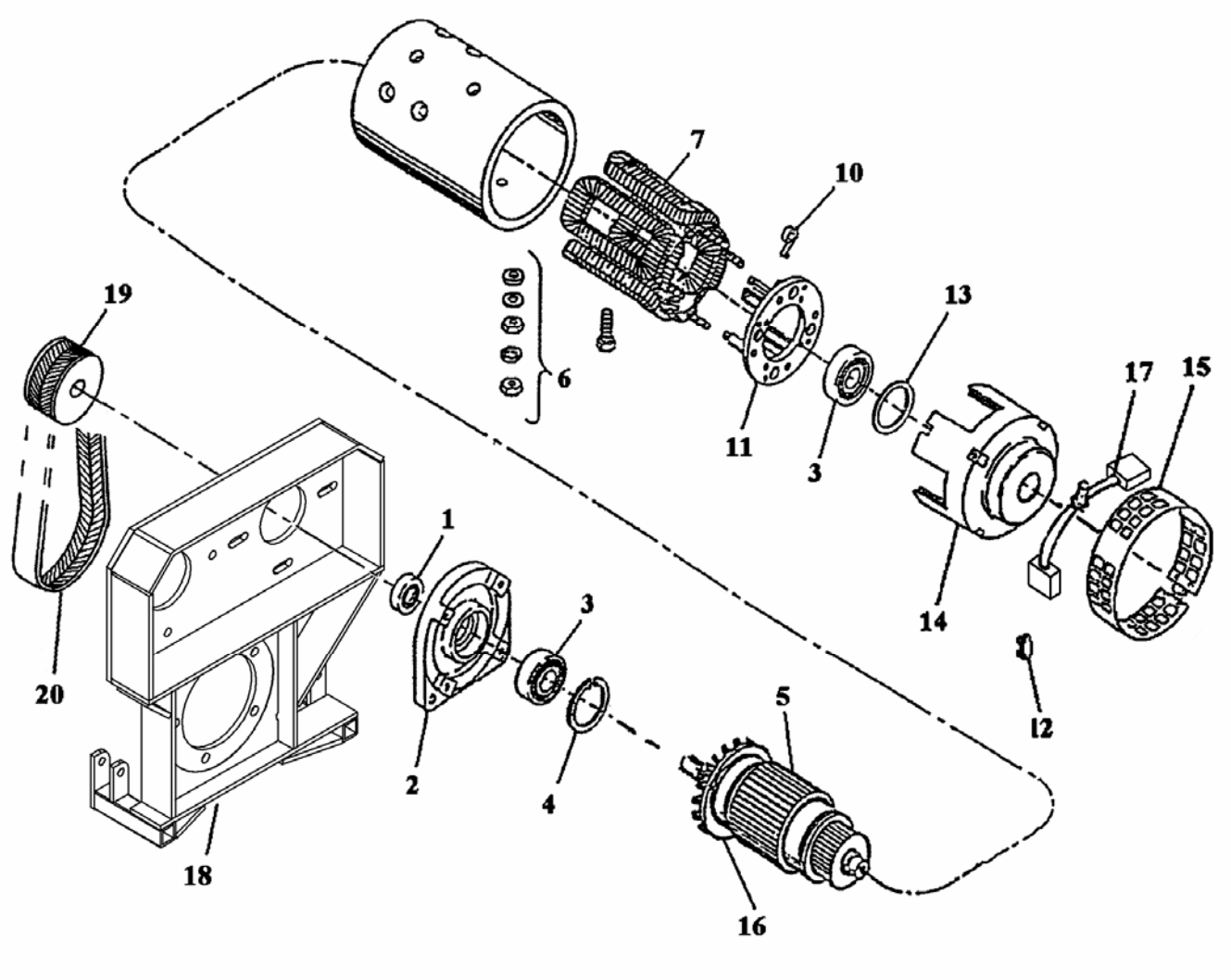
* EE version

FRONT AXLE, SUSPENSION, STEERING, DISC BRAKES



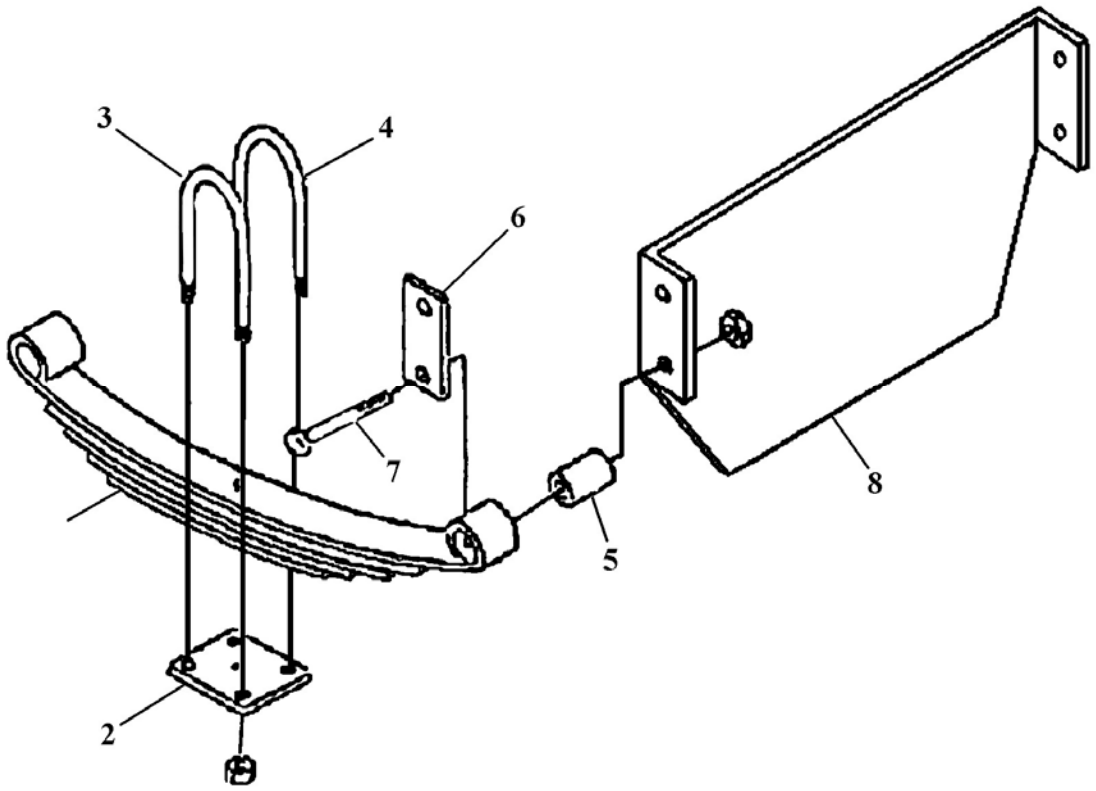
REF	*PART NO*	*DESCRIPTION*
1	2208240001	STEERING WHEEL
2	481452	NUT 3/4-16
3	2208240002	COVER
4	481454	PIN
5	3030021	OIL SEAL
6	3030020	BUSHING
7	481457	BUSHING
8	2200300002	TUBE
9	2207000001	ROD END, LEFT HAND
	2207000002	ROD END, RIGHT HAND
10	2910000005	NUT, LEFT HAND
	2910000006	NUT, RIGHT HAND
11	2207320001	FRONT TIE ROD
11A	481460	TIE ROD
12	481462	RIGHT AXLE
	481472	LEFT AXLE
13	481464	AXLE BEAM
14	2205250001	KING PIN
15	2910300001	NUT 3/4-NF
16	2103250001	THRUST BEARING
17	2914364001	BUSHING
19	2229300002	OIL SEAL
20	2103300001	TAPER BEARING
21	2224300001	HUB
22	2910300003	WHEEL BOLT
23	2103300002	TAPER BEARING
24	2229300001	DUST CAP
25	481431	RIGHT CALIPER
	481430	LEFT CALIPER
26	481432	FLEX. HOSE
27	2120236001	DISC
28	2916000001	U-BOLT
29	2192280001	LEAF SPRINGS
30		NUT 1/2-NF
31		BOLT 5/8-NC
32	2182320001	SHACKLE LINK
33	2183240002	BUSHING
34		NUT 5/8-NC
35	2180240001	SHOCK ABSORBER
36	2184448001	PLATE
37	481434	BOLT, LONG
	481442	BOLT, SHORT
38	481440	BOLT
39	481441	WASHER
40	2200300003	SHAFT
41	481466	SCREW
42	2117250001	GEAR
	4430002	GEAR FOR TILT/TEL. STEERING
43	2207320009	ARM
44		BOLT 7/16-NC
45	481470	LOCK WASHER
46	481471	NUT
47	2814003	PADS
48	481474	STEERING SUPPORT
49	2910300002	CASTELLATED NUT
50	3614002	BUSHING, LONG
	3614003	BUSHING, SHORT
51	2330014	HORN COVER
52	2330013	STEERING WHEEL
53	2230014	ADJUSTABLE COLUMN
54	2330015	UNIVERSAL JOINT
55	2200224003	SHAFT
56	2200224001	NYLON COUPLER
57	2200224002	SHAFT
58	4430001	UNIVERSAL JOINT
59	481466	SCREW
60	2230023	SELECTOR BOX
61	2230015	COLUMN MOUNTING PLATE
62	2230016	NYLON WASHER
63	2230017	NYLON BUSHING

D00-4002 SEPEX MOTOR AND DRIVE



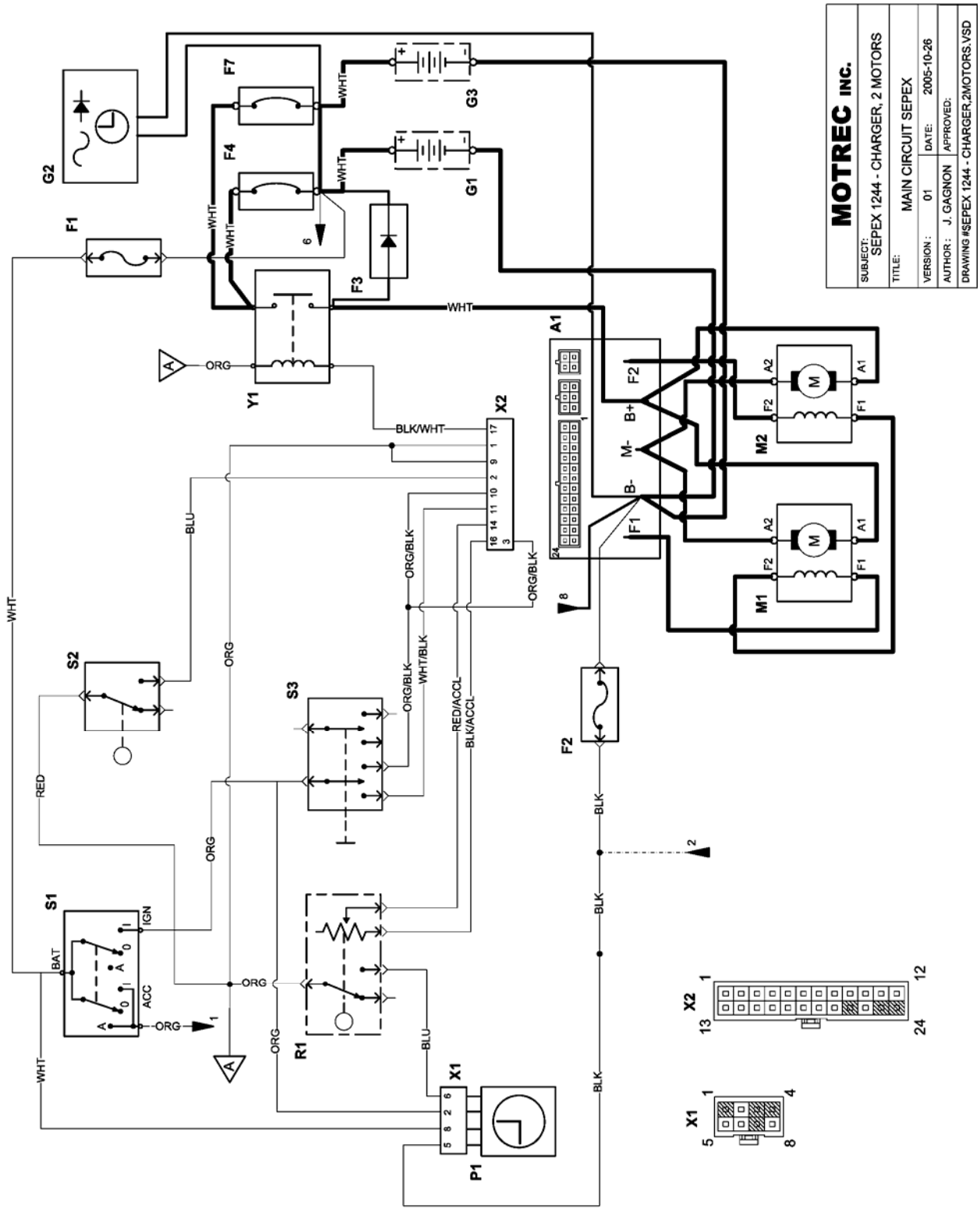
REF	*PART NO*	*DESCRIPTION*	*REF*	*PART NO*	*DESCRIPTION*
	2450003	MOTOR ASS.	11	2450007	BRUSH PLATE ASS
1	484001	SEAL	12	2450010	HOLE PLUG
2	484002	DRIVE ENDHEAD	13	484013	WAVY WASHER
3	484003	BEARING	14	2450009	COMMUTATOR ENDHEAD
4	484004	SNAP-RING	15	484015	HEAD BAND ASS
5	484016	ARMATURE FAN	16	2450004	ARMATURE ASS.
6	484006	NUT-WASHER PACK.	17	2450006	SPRINGS
7	2450011	FIELD COIL KIT	18	CALL FACTORY	MOTOR BASE
	2152002	BELT TENSIONER	19	CALL FACTORY	PULLEY
10	2450008	2 BRUSHES & LEAD ASS.	20	CALL FACTORY	BELT

REAR SUSPENSION

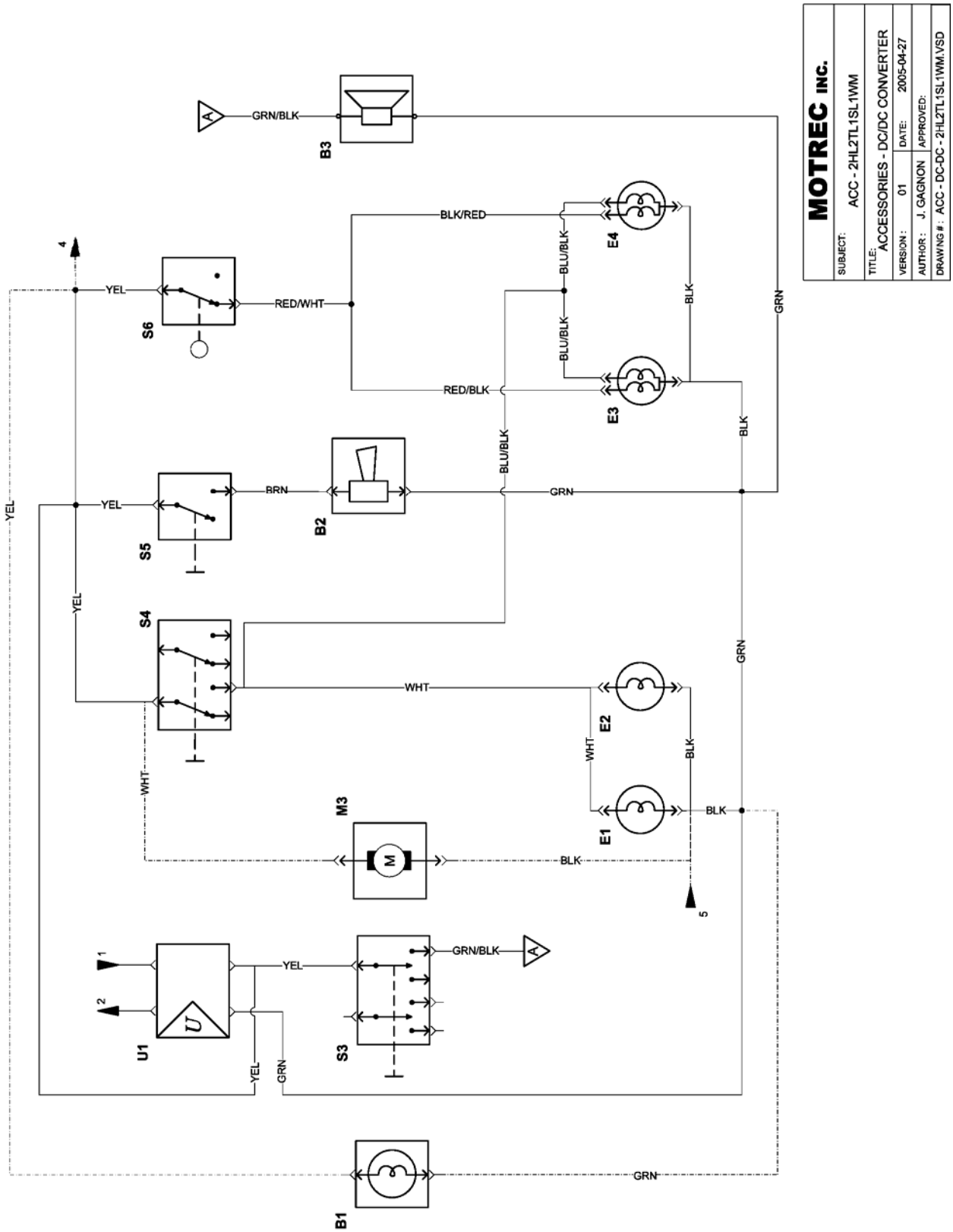


REF	*PART NO*	*DESCRIPTION*
1	2192320001	LEAF SPRING
2	2185280001	MOUNTING, LEAF SPRING
3	3640004	U BOLT, 3 ½ I.D.
4	5040004	U-BOLT, 4 I.D.
5	2183240002	BUSHING
6	2182320002	BAR
7	242057	BOLT
8	2182448004	REAR SUSPENSION PLATE

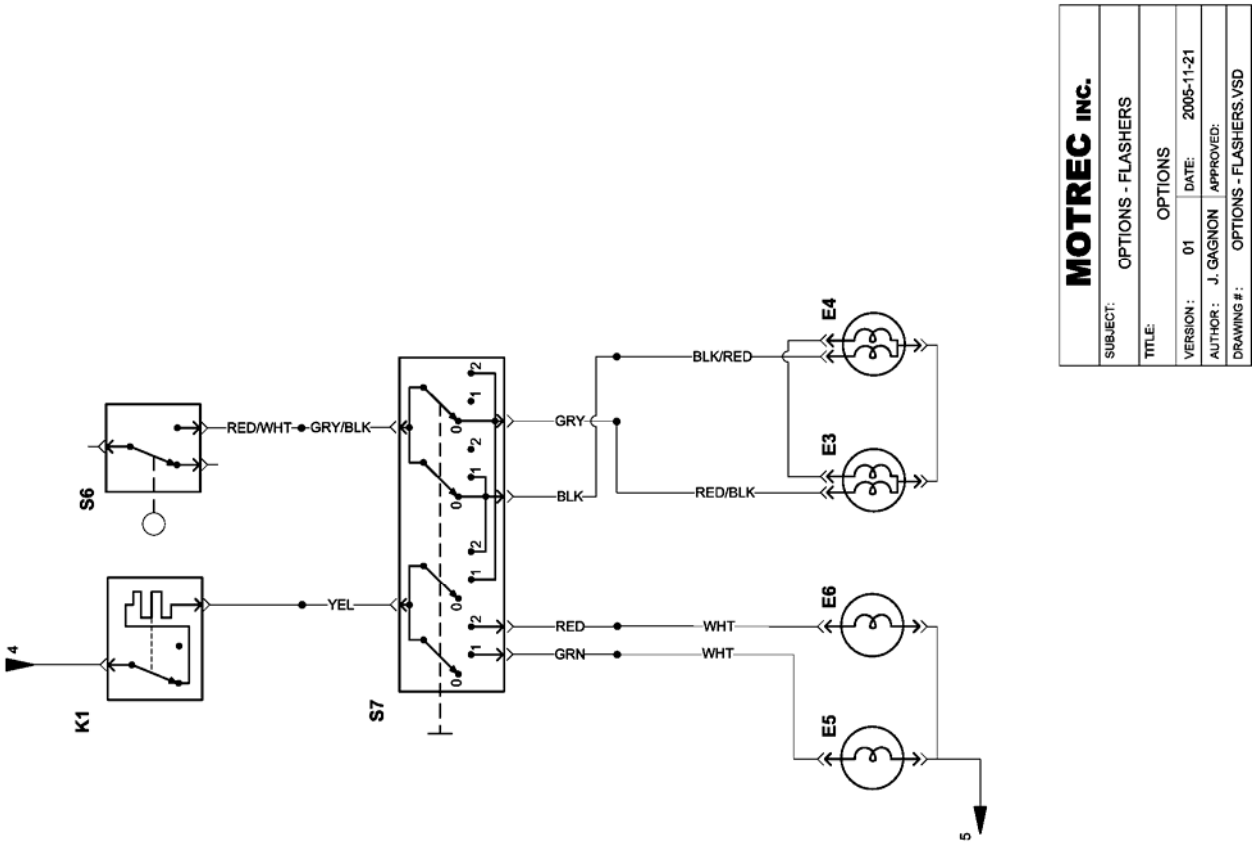
ELECTRICAL DIAGRAM – SEPEX MAIN CIRCUIT



ACCESSORIES – DC-DC CONVERTER
ACCESSOIRES – CONVERTISSEUR DC-DC



OPTIONS


MOTREC INC.
SUBJECT: OPTIONS - FLASHERS
TITLE: OPTIONS
VERSION: 01
DATE: 2005-11-21
AUTHOR: J. GAGNON
APPROVED:
DRAWING # : OPTIONS - FLASHERS.VSD
S6
K1
S7
RED/WHT
GRY/BLK
YEL
GRY
BLK
BLK/RED
RED/BLK
RED
GRN
WHT
WHT
E4
E3
E6
E5
4
5

PARTS LIST

NO	DESIGNATION	REF	QTY
A1	SEPEX SPEED CONTROL	1244-5651	1
B1	STROBELIGHT	*	1
B2	HORN	*	1
B3	REVERSE ALARM	*	1
E1-E2	HEADLIGHT	*	2
E3-E4	TAIL/BRAKE LIGHT	*	2
E5-E6	AMBER FRONT LIGHT	*	2
E7-E8	BACKUP LIGHT	*	2
F1-F2-F8	FUSE	246108	2
F3	DIODE BRIDGE	3669027	1
F4-F7	CIRCUIT BREAKER, 150A	2869001	2
G1	BATTERY		
G2	BATTERY CHARGER		1
G3	BATTERY (OPTIONAL)		
K1	FLASHER RELAY	3069004	1
M1	SEPEX MOTOR		1
M2	SERIES MOTOR		1
M3	WIPER MOTOR	*	1
M4	CAB HEATER 48V	4869020	1
P1	INDICATOR (BDI), HOUR METER	*	1
R1	ACCELERATOR	367001	1
	MICROSWITCH	367002	1
	POTENTIOMETER	367003	1
	PLASTIC GEAR	367015	1
S1	KEY SWITCH	246205	1
S2	SEAT SWITCH	247002	1
S3	FOWARD/REVERSE SELECTOR	266211	1
S4	LIGHT SWITCH, ROCKER TYPE	1269004	1
	LIGHT SWITCH, PUSH/PULL	486002	1
S5	HORN BUTTON	*	1
S6	BRAKE LIGHT SWITCH	246207	1
	HYDRAULIC BRAKE LIGHT SWITCH	2374001	1
S7	FLASHER SWITCH	*	1
U1	DC-DC CONVERTER		1
X1	HOUR METER CONNECTOR		1
X2	SPEED CONTROL CONNECTOR		1
X3	BATTERY CHARGER CONNECTOR		1
Y1	MAIN CONTACTOR	486222	1
Y2	HEATER SOLENOID	246101	1
	STATIC STRAP	90330	1

* Consult Motrec Illustrated parts

MOTREC ILLUSTRATED ACCESSORIES

Strobelight, polemount
Amber 12-80V: 3116000001
Red 12-80V: 2469001
Blue 12-80V: 3690008

Strobelight, cab mount
Amber 12-48V: 3116250001
Red 12-48V: 3069026
Blue 12-48V: 3069014
Amber 72-80V:3116720001
Red 72-80V: 3116720002
Blue 72-80V: 3116720003

Amber turn lamp
12V: 3069020
Bulb 12V: 3069021

Red Tail/Brake light
Grommet: 3269001
Plug: 246012A
12V : 2469021
24V : 2469022

Red Tail/Brake light
12V: 386002

Red Tail/Brake light
Housing: 3069012R
Bulb 12V: 3117240001

Back-up lamp
Grommet: 3269001
12V: 3669012
24V: 3669012A

Clear lamp
12V: 3069012
Bulb 12V: 1269008

Pedestral head lamp
12V: 2569001
Bulb 12V: 2569001B
Bulb 24V: 4469001

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3111480006
Bulb Turn: 3111480008
Bulb Mark: 3111480007

Headlight
Left: 3111480009
Right: 3111480010
Bulb H/L: 3111480011
Bulb Turn: 3111480012
Bulb Mark: 3111480013

Turn signal switch
246050

Analog Voltmeter
12V : 3069007
24V : 2469002
36-48V : 3669002

HOBBS Gauge
24V: 2469026
36V: 3069038
48V: 4869037

Horn
12V: 246003
24V: 246013

Horn button VIP
2330014

Horn button, column mount
246210

Horn button, dash mount
266210

Horn button 3109250001

Limit switch
3030015

Back-up alarm
12-48V : 3100000001
72-80V : 3105720001

DC-DC converter, 10A
12-48V: 3069019

DC-DC Converter, 25A
12-48V: 3124000002
72-80V: 3124720001

Wiper motor
12V: 3113000001
24V: 486211

Wiper arm 2800000001

Wiper blade
14” Blade: 2800000002
18” Blade: 2800000003

Pantograph wiper arm
246233A

Pantograph wiper blade
246233

Cab heater
12V: 3103300001
36V: 3669008
48V: 4869020

12V Dome light 3669006

12V Fan 3669013

Headlamp 12V:3111250001

Headlamp
12V: 3111300001
Bulb 12V: 3111300002

Red Pilot light
12V: 246212
Bulb 12V: 246212B

CONVERTER INSTALLATION

Installation and Trouble Shooting Guide
SY1200-25

The SY1200-25 is a state of the art DC-DC converter. There are many new features, and special care is required to install this unit properly. If you have problems with the operation of this unit please check the installation procedures for help.

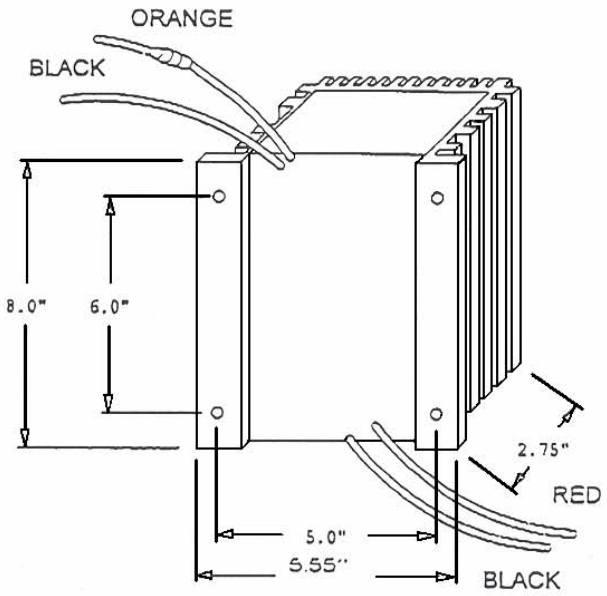
The **ORANGE** wire is the **INPUT POSITIVE>**

The **BLACK** wire near the orange wire is the **INPUT NEGATIVE>**

The RED wire is the **OUTPUT POSITIVE.**

The **BLACK** wire near the red wire is the **OUTPUT NEGATIVE.**

NOTE: Use the correct black wire for input and output. Do not connect the black wires together. (The black wires are common however, due to the high currents developed in this unit it is necessary to maintain proper electron flow to reduce noise.)



The converter must be mounted on a metal surface for proper heat dissipation. A vertical mounting position is best to maximize the convection process. The unit will shut down thermally under high currents if not properly mounted.

This unit is equipped with digital logic capabilities. The input voltage is monitored to determine acceptability. If the input voltage is below the MIN or above the MAX limits the SY1200-25 will NOT turn on.

The fuse in this unit has no determining factors as to the current carrying capabilities of the converter. The fuse serves only one purpose, and that is to remove the unit from your power source in the event of a failure. The SY1200-25 has a very advanced control section, and will determine when to open the fuse. An open fuse will mean, that a problem had occurred, that does not mean that the problem still exists, or that the problem has gone away.

<<DO NOT increase or by'pass the fuse. USE ONLY A FUSE RATED AT 250V 20A>>

Potential reasons for an open fuse are as follows: (1) The output voltage rises above 18 VDC. This problem can occur when an inductive load is removed or applied at high currents. This is a noise spike and the converter will shut down if it can not suppress the spike. (2) Reverse polarity on the input or output. (3) A chaos condition where the output becomes unstable. (4) Excessive noise or spikes on the input.

Mount this unit as close to the highest current load as possible. (This unit uses true switching techniques to step down the input voltages. The higher the input voltage the lower the input current for a 25 AMP load. The high currents are on the output of the converter.) Use 14 gauge wire for the input up to 5 feet. Use 12 gauge wire for up to 10 feet. Increase the wire gauge for each additional 5 feet of wire. NEVER use less than a 10 gauge wire on the output. If the wire length exceeds 5 feet use 8 gauge wire. IMPORTANT: Use a crimp type of connector to attach the wire to the converter. DO NOT twist the wires together. A poor connection will not only allow the converter to operate poorly, but at 25 amps the connection WILL GET HOT AND BURN IN TWO.

WARNING: THE CHASSIS IS ISOLATED FOR HIGH VOLTAGE APPLICATIONS. DO NOT USE THE CHASSIS FOR GROUND.

BATTERY DISCHARGE INDICATOR (HOBBS)

This indicator monitors :
- the residual capacity of batteries;
- operating hours;
- status of service down counter.

The residual capacity of the battery is monitored via an 8-LED bar display. When the left red LED lights, the batteries must be charged to avoid damage. The LED display starts flashing as a pre-warning signal. The lower voltage limit is adjustable via potentiometer “M” on the rear.

A	B	C	D	E	F	G	H	I	J	K
1,57	1,63	1,68	1,73	1,78	1,82	1,84	1,86	1,89	1,91	1,93

In order to activate a new adjustment, the unit has to be reset :
- 2.35V/cell reset voltage with battery remaining in vehicle;
- 2,09V/cell reset voltage after battery has been disconnected.

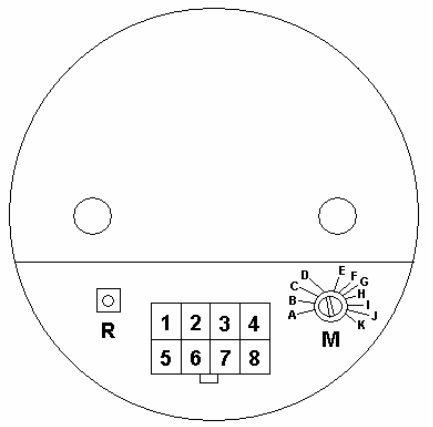
To maintain a good battery performance, it is recommended to limit the discharging to 80% of the battery capacity. The recommended setting for 6V batteries is F and the recommended setting for an industrial battery is K.

An internal relay can prevent overdischarging and damaging the batteries. The relay can be wired to cut off the reverse direction, or energize an N.C. relay and alarm.
Turning off and on the vehicle will override the protection for 30 sec.

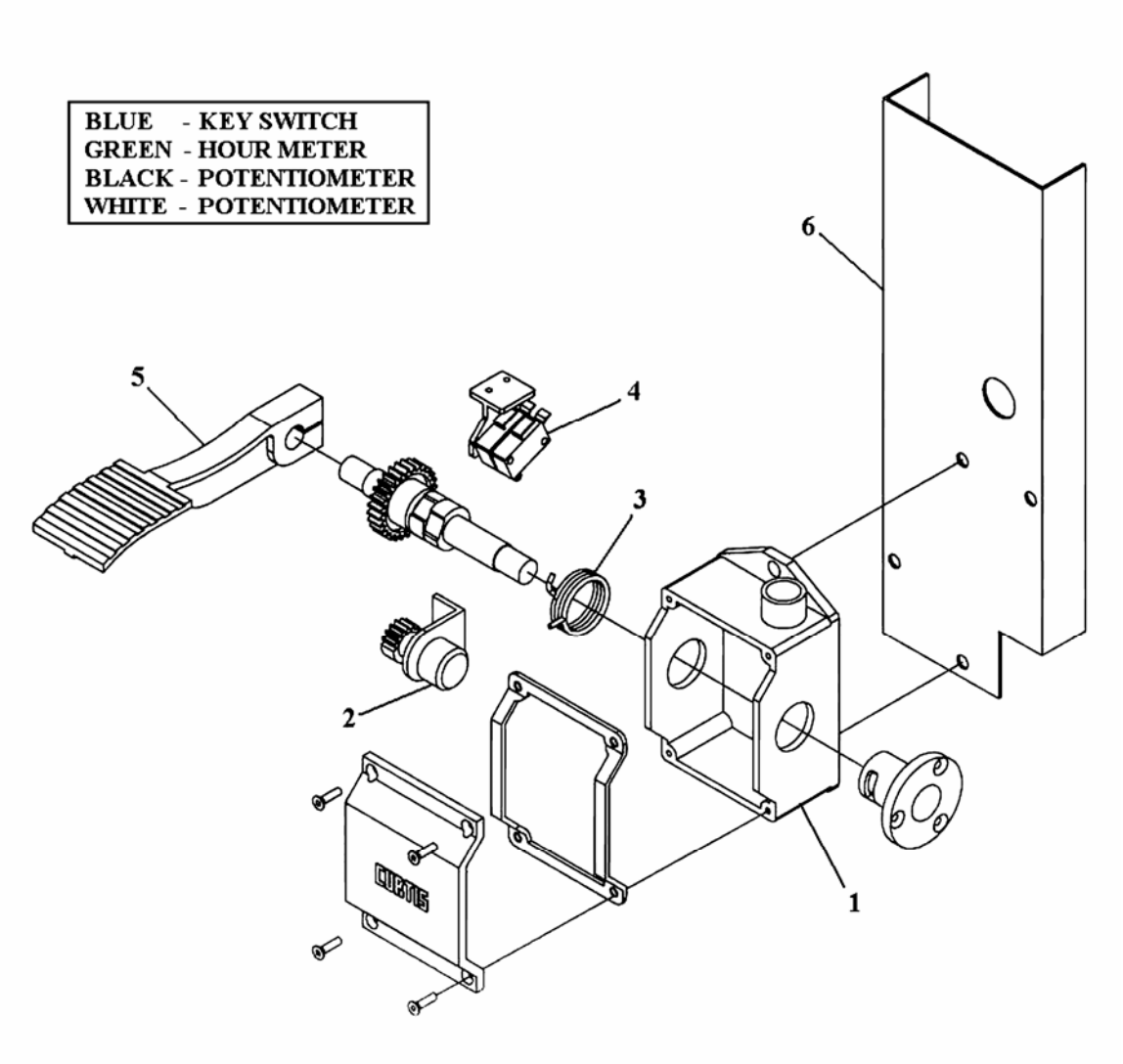
The current status (remaining operating hours before maintenance) of the service down counter is indicated for a period of 5 seconds after the key switch is turned on. When it is down to 0, the display flashes. After the maintenance, reset the counter: depress the button “R” on the rear. The service counter is factory programmable only.

24V UNIT #: 2469026
36V UNIT #: 3069038
48V UNIT #: 4869037

2- Orange, key switch
3- Relay +
4- Relay -
5- Black, battery –
6- Blue, hour counter
8- White, battery +



CURTIS FOOT PEDAL



REF.	*PART. NO*	*DESCRIPTION*
1	***3062001C***	***ACCELERATOR CURTIS***
2	***367008***	***POTENTIOMETER***
3	***2262004C***	***SPRING***
4	***2262001C***	***MICRO-SWITCH***
5	***2262003C***	***LEVER***
6	***3662002***	***CABLE PROTECTOR***

RESP : ***CLAUDE L***	MODEL(E) : **E-320/360/480/500**
NO : ***321A320001***	*SER :* ***1018799*** *TO/À :* ***1019973***